BULLETIN OF THE IMPERIAL INSTITUTE

A QUARTERLY RECORD OF PROGRESS IN TROPICAL AGRICULTURE AND INDUSTRIES AND THE COMMERCIAL UTILISATION OF THE NATURAL RESOURCES OF THE COLONIES AND INDIA

EDITED BY THE DIRECTOR AND PREPARED BY THE SCIENTIFIC AND TECHNICAL STAFF OF THE IMPERIAL INSTITUTE AND BY OTHER CONTRIBUTORS

VOL. XII. 1914

LONDON
JOHN MURRAY, ALBEMARLE STREET, W.

ERRATUM TO VOL. XII

p. 144, line 31, *for* Mr. R. S. Troup, F.L.S., *read* Mr. R. S. Pearson, F.L.S.

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THE IMPERIAL INSTITUTE

OF THE

UNITED KINGDOM, THE COLONIES, AND INDIA

THE Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Dominions, Colonies, and India, and providing for their investigation, and for the collection and dissemination of scientific, technical, and commercial information relating to them.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which H.R.H. the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of H.M. Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned, subject to certain rights of usage by the Imperial Institute, for occupation by the University of London. In July 1902 an Act of Parliament was passed transferring the

management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee including representatives of the Dominions, Colonies, and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on January 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated by each of the three Government Departments chiefly concerned, has been appointed, and at present consists of Mr. C. A. Harris, C.B., C.M.G., M.V.O.; Sir Alfred Bateman, K.C.M.G.; and Sir John P. Hewett, G.C.S.I., C.I.E.

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, C.M.G., M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy, and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

A Report by the Director on the Work of the Imperial Institute is presented to Parliament annually.

The following are the principal departments of the Institute:

Exhibition Galleries.—The collections of economic products, etc., illustrative of the general and commercial resources of the Dominions, Colonies, and India, are

arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday, and Christmas Day, from 10 a.m. to 5 p.m. (10 a.m. to 4 p.m. in winter.)

The following British Dominions, Colonies, and Dependencies are represented by Collections, which are in charge of Technical Superintendents:

Canada, Newfoundland; Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahamas, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda; Falkland Islands; New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, Papua, New Zealand; Fiji, Western Pacific Islands; Union of South Africa, Rhodesia, Nyasaland, St. Helena; Gambia, Sierra Leone, Gold Coast, Nigeria; East Africa Protectorate, Zanzibar and Pemba; Uganda; Somaliland; the Anglo-Egyptian Sudan; Malta; Cyprus; Ceylon; Hong Kong; Mauritius; Seychelles; Straits Settlements, the Federated Malay States; and India.

Special arrangements are made to conduct parties from schools and institutions through the Colonial and Indian Collections for educational purposes.

A Central Stand for Publications and an Enquiry Office have been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Handbooks, pamphlets, circulars, etc., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. Lists of the publications available for distribution or sale are pro-

vided, and the principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the Departments in the main building.

In 1913 the public galleries were visited by 214,900 persons, and 19,910 Colonial and Indian publications were distributed.

Scientific and Technical Research Department.—The research laboratories and workrooms of this Department were established in order to provide for the investigation of new or little-known natural products from the Colonies and India and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade, and industries of the Colonies and India.

The work of this Department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the Department for investigation such natural products of the countries to which they are appointed as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the Department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

A Reference Sample Room is maintained in this Department, in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Department works in co-operation with the Agricultural, Mines and other technical Departments in

the Colonies, whose operations it supplements by undertaking such investigations as are of a special scientific or technical character connected with agricultural or mineral development, as well as enquiries relating to the composition and commercial value of products (animal, vegetable, or mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which was printed in a volume of *Technical Reports and Scientific Papers*, published in 1903. A series of Selected Reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these Selected Reports, five have been published: Part I. "Fibres" (Cd. 4588), Part II. "Gums and Resins" (Cd. 4971), Part III. "Food Stuffs" (Cd. 5137), Part IV. "Rubber and Gutta Percha" (Cd. 6022), Part V. "Oil-seeds, Oils, Fats and Waxes" (Cd. 7260).

Mineral surveys, under the supervision of the Director of the Imperial Institute, and conducted by Surveyors selected by him, are in progress in several countries. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained. Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

Tropical African Services Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa.

Instruction in the subject of Tropical Economic Products in this Course is given by a member of the staff of the Imperial Institute.

Library and Reading-Rooms.—The library and reading-rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and technical periodicals of the United Kingdom, the Dominions, the Colonies, India, and Foreign countries.

The library and reading-rooms are on the first floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute, and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownagree corridor and rooms in connection with this hall are in the occupation of the Indian Section of the Imperial Institute, whilst the hall is available for lectures, meetings, etc.

The "Bulletin of the Imperial Institute" is published quarterly by Mr. John Murray, 50A, Albemarle Street, London, price *2s. 6d.* (annual subscription 11*s.*, including postage), and may be purchased through any bookseller or from agents in the Colonies and India. The BULLETIN contains records of the principal investigations conducted

for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (animal, vegetable, and mineral).

Imperial Institute Handbooks on Tropical Resources.—The Secretary of State for the Colonies has authorised the preparation of a series of handbooks dealing with the Commercial Resources of the Tropics, with special reference to West Africa. The handbooks are edited by the Director of the Imperial Institute, and published by Mr. John Murray. The first three volumes are: *The Agricultural and Forest Products of British West Africa*, by Gerald C. Dudgeon, Director-General of Agriculture in Egypt, and lately Inspector of Agriculture for British West Africa, price 5*s.* net; *Cocoa: Its Cultivation and Preparation*, by W. H. Johnson, F.L.S., Director of Agriculture in Southern Nigeria, price 5*s.* net; and *Rubber: Its Sources, Cultivation, and Preparation*, by Harold Brown, Technical Superintendent, Scientific and Technical Department, Imperial Institute, price 6*s.* net.

The following Societies have their offices at the Imperial Institute:

International Association for Tropical Agriculture, British Section.—The object of this Association, the Central Bureau of which is in Paris, is the promotion of the scientific and practical study of all questions connected with tropical agriculture and the development and utilisation of natural resources, especially of tropical countries. The British Section has its headquarters at the Imperial Institute. Members of the British Section are permitted to use the library and reading-rooms of the Imperial Institute, and a writing-room has been also

provided for their use. The Association will hold an International Congress of Tropical Agriculture in London from the 23rd to the 30th June, 1914. The British Section will be responsible for the organisation of this Congress.

British Women's Emigration Association.—The British Women's Emigration Association has been assigned offices on the mezzanine floor, which are open daily from 10 a.m. to 4 p.m. Advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge. This Association works in co-operation with the Emigrants' Information Office in Westminster.

Colonial Nursing Association.—An office has been allotted on the mezzanine floor to this Association. The principal object of the Association is the selection of trained hospital and private nurses for service in the Crown Colonies and Dependencies.

Tropical Diseases Bureau.—Temporary office accommodation on the mezzanine floor has been provided for this Bureau, the main purpose of which is to collect information regarding tropical diseases and to distribute it as widely as possible among those who are engaged in combating such diseases.

Bureau of Universities of the British Empire.—An office on the mezzanine floor has been allotted to this Bureau, the object of which is the collection and dissemination of information relating to the Universities of the British Empire.

THE IMPERIAL INSTITUTE

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Tropical African Services Course

Instructor in Tropical Economic Products: S. E. CHANDLER, D.Sc. (Lond.), F.L.S.

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial, Indian, and other Governments concerned.

SOME ECONOMIC PRODUCTS OF SOMALILAND

THE exports of Somaliland are valued at about 3,250,000 rupees (£217,000 approx.) per annum and include ostrich feathers, leather, hides, live-stock, ghee (clarified butter), guano, pearls, mother-of-pearl shells, Sansevieria fibre, myrrh, frankincense, and gums.

The three last-mentioned items are of considerable interest, since comparatively little has been known until recently regarding the trees which yield them, and even now the information available is by no means complete. It is therefore of interest to place on record the results of examination of a series of authentic samples of products of these and allied types, which was collected by Dr. Drake-Brockman, of the Somaliland Medical Service, and sent to the Imperial Institute for examination. Botanical specimens of the plants yielding many of these products were also collected by Dr. Drake-Brockman and sent to the Royal Botanic Gardens, Kew, for investigation, and this work is still in progress.

With reference to the native names assigned to these products, it may be explained that the name "habbak" is a generic name applied by the Somalis to all products of these classes, the various kinds being distinguished by the addition of the vernacular names of the trees from which the products are derived, thus; "habbak adad" is

the gum of the "adad" tree (*Acacia Senegal*, Willd.). In certain cases, however, an alternative name is used. Thus the tree yielding myrrh is called "didin" (pronounced didthin), but the name "habbak didin," which would, according to the general rule, be used for myrrh, is replaced by "malmal," and the two varieties of myrrh produced in the country are distinguished by prefixing the names of the regions in which they are collected, thus "Ogo malmal" and "Guban malmal," the former being obtained in Ogo, the high internal plateau region, and the latter being collected in Guban, the low-lying maritime plains.

The materials received at the Imperial Institute belonged to three different classes, viz. true gums, gum-resins, and resins. As there is considerable confusion in the application of these terms, it may be explained that in this report the term gum is restricted to products completely miscible with water and forming more or less viscous solutions. The resins, on the contrary, are insoluble in water, but dissolve to a greater or less extent in other liquids such as alcohol or turpentine oil, whilst the gum-resins are natural mixtures of gum and resin, and consequently are only partially soluble in water, the portions insoluble in this liquid being usually soluble in alcohol, turpentine oil, or some similar solvent. Some of the gum-resins also contain small quantities of essential oils, *i.e.* odoriferous oils, that can be separated from the gum and resin by placing the crude product in water and treating it with a current of steam.

The present investigation had for its first object the classification of these products into the three groups thus briefly described. This having been done, each product was further examined to determine its quality and value, if any. In recording the results of this work it is convenient to discuss the products under the three groups to which they belong.

In the following pages the introductory matter relating to the various products has been derived from Dr. Drake-Brockman's book, *British Somaliland* (see this BULLETIN, p. 159), and, in the case of the gums, also from notes kindly furnished by him.

Gums

In order that a gum of the "arabic" type may be of commercial value it should be completely soluble in water, of pale colour, and devoid of unpleasant taste or characteristic odour. Its solution in water should also be viscous and possess good adhesive properties. For further information on this subject the Selected Reports from the Scientific and Technical Department of the Imperial Institute, Part II., Gums and Resins (Colonial Reports, Miscellaneous [Cd. 4971], 1909) should be consulted.

Habbak adad.—This gum, the product of *Acacia Senegal*, Willd. (*A. Verek*, G. and P.), the tree which also yields the best gum in the Anglo-Egyptian Sudan, Senegal, and Nigeria, is stated to be the best of the Somali acacia gums. It is found in "tears" or globular masses, varying in size from that of a cherry to a turkey's egg, and except in the case of pieces which are old or have been exposed to the weather for some months, is usually translucent and nearly colourless. Even in the larger old pieces there is seldom more than a flesh-pink tinge. This gum is largely exported; it is carefully collected, seldom being mixed with other and inferior varieties, and is brought to the coast in goat-skin bags. It is cleaned in Aden, whence the better quality is shipped to Europe, while the remainder goes to Bombay. *A. Senegal* is found all over British Somaliland, but more commonly in Ogo. It is a medium-sized, ragged tree, which seldom exceeds 10 to 12 ft. in height.

Two samples of this gum were received at the Imperial Institute and were examined, with the following results:

No. 1.—This consisted of tears of transparent, clean, "glassy" gum, varying in colour from pale straw to pale pinkish-brown, and having a vitreous fracture.

No. 2.—This sample, which was stated to be an old specimen of "habbak adad," consisted of tears, pieces of large tears, and small fragments of clean, transparent, "glassy" gum, varying from nearly colourless to pinkish-brown. The mucilage was nearly colourless and possessed good adhesive properties.

The samples were submitted to chemical examination,

with the following results, compared with samples of *A. Senegal* gum from the Sudan, Senegal, and Nigeria previously examined at the Imperial Institute (this BULLETIN, 1908, **6**, 38; 1910, **8**, 359; this vol. p. 31).

	No. 1.	No. 2.	Sudan gum.	Senegal gum.	Nigerian gum.
Moisture . . *per cent.*	13·6	12·3	11·3 to 13·2	16·0 to 16·1	10·2 to 13·5
Ash . . . *per cent.*	2·4	4·0	3·1 to 3·3	3·0 to 3·5	2·8 to 3·5
Matter insoluble in water *per cent.*	2·9	6·0	—	—	0·1 to 1·9
[1] Acid number . . .	2·2	3·6	1·2 to 2·4	0·8 to 1·9	3·2 to 3·3
Specific rotation at 20° C., in water . . .	−33° 40′	−23° 10′	—	—	−23° 40′ to −26° 50′
[2] Relative viscosity of a 10 per cent. solution at 22° C. .	7·2	20·1	16·3 to 31·4	22·5 to 32·4	5·36 to 6·66

[1] *Milligrams of potassium hydroxide required to neutralise* 1 *gram of gum.*

[2] *As compared with* 1 *for water, determined under the same conditions.*

Sample No. 2 showed the usual characters of old gum, in containing more "insoluble matter" and in having a higher viscosity.

Samples of both gums were submitted to brokers, who classed No. 1 as "clean, palish, glassy" gum arabic, and valued it at 27*s.* 6*d.* per cwt. in London (March 1913), with "glassy" Sudan gum arabic at 31*s.* per cwt. and "bas du fleuve" Senegal gum at 81 francs per 100 kilos. in Bordeaux, while No. 2 was valued at 30*s.* per cwt. (August 1913).

Habbak wadi.—The species of acacia which yields this gum has not yet been determined. The gum is of good quality and inferior only to "habbak adad." It is found in globules which vary in size from that of a pea to that of a pigeon's egg or even larger, and is sometimes seen in large, irregularly shaped masses. The small pieces are usually colourless and translucent, but the larger pieces are often pinkish-yellow or brown in colour. This gum is brought down to the coast either unmixed with other varieties or mixed with "habbak adad," which it somewhat resembles. The "wadi" tree grows only in Western Somaliland, where it extends for miles along the banks of the large rivers, being common on the banks of the Webi Shebeleh, Ganale, Wabi, and Juba. The tree reaches a height of 20 ft., and possesses a whitish bark.

The specimen received at the Imperial Institute was collected in the Ogaden country, and consisted of small tears and fragments of gum, varying from nearly colourless to pale reddish-brown.

This gum was soluble in water. The mucilage was reddish-brown, and possessed good adhesive properties.

The gum was analysed, with the following results:

Moisture	*per cent.*	12·0
Ash	*per cent.*	3·6
Matter insoluble in water	*per cent.*	1·0
Acid number		5·3
Relative viscosity of a 10 per cent. solution at 22·0° C.		6·3

This sample was valued by brokers at 24*s.* to 25*s.* per cwt., less 2½ per cent. discount, in London (August 1913).

Unnamed gum.—No information was supplied as to the botanical source of this sample. It consisted of small tears and pieces of "glassy" gum, soluble in water and mostly of a pale colour, but in some cases reddish-brown. The mucilage was reddish-brown, and possessed good adhesive properties.

On analysis, the sample gave the following results:

Moisture	*per cent.*	12·2
Ash	*per cent.*	3·6
Matter insoluble in water	*per cent.*	2·9
Acid number		6·0
Relative viscosity of 10 per cent. solution at 22·0° C.		7·8

This gum was valued by brokers at 23*s.* to 24*s.* per cwt., less 2½ per cent. discount, in London (August 1913). It was quite similar to "habbak adad" No. 1 (see p. 13), and its lower value was due chiefly to its darker colour.

Habbak hinni.—The species of acacia which yields this gum has not yet been determined. The gum is occasionally found mixed with "habbak adad," and occurs in colourless translucent "tears," in large, irregular, yellowish-red pieces, or in reddish, globular masses. It can never be collected in large quantity, as the trees are not numerous and the gum is only exuded in small quantities. The "hinni" acacia is found in the Guban (the maritime plain) and in

the Haud. It is a low-growing tree, and seldom exceeds 3 to 4 ft. in height.

The sample examined at the Imperial Institute consisted of small masses, tears, and fragments of gum, varying in colour from pale straw to dark reddish-brown. A few pieces of "burnt" gum were also present. The gum was soluble in water, and the mucilage possessed good adhesive properties.

The gum was analysed, with the following results:

Moisture	*per cent.*	12·5
Ash	*per cent.*	3·6
Matter insoluble in water	*per cent.*	1·1
Acid number		4·8
Specific rotation at 20° C. in water		−47° 20′
Relative viscosity of 10 per cent. solution at 22·0° C.		6·1

This sample was valued by brokers at 15*s.* to 17*s.* 6*d.* per cwt., less 2½ per cent. discount, in London (August 1913). Gum of this type, free from "burnt" and dark-coloured fragments, would fetch a much better price.

Habbak billeil.—This gum is also obtained from an undetermined species of acacia, and is usually found in more or less globular masses, which vary in size from that of a cherry to that of a hen's egg, and are translucent and of reddish or brownish tint. It is not collected by the Somalis except for eating. The "billeil" tree does not exceed 12 ft. in height, and is a ragged-looking acacia not unlike the "adad" (*A. Senegal*). It grows freely in the internal plateau, where it is one of the commonest of the acacias. It seems to prefer the less stony areas of this region.

A sample of this gum, collected at Gondar Libah and Gubato in Ogo, was received. It consisted of irregular tears and fragments of translucent gum, varying in colour from pale brown to dark red-brown. The mucilage possessed good adhesive properties.

The gum was analysed, with the following results:

Moisture	*per cent.*	11·2
Ash	*per cent.*	2·8
Matter insoluble in water	*per cent.*	1·7
Acid number		5·4
Relative viscosity of a 10 per cent. solution at 22·0° C.		16·0

This gum was valued by brokers at 10*s.* per cwt., less 2½ per cent. discount, in London (August 1913).

As regards the following six varieties of gums, it should be mentioned that it is not by any means certain that the samples received at the Imperial Institute are typical, but examination of the further specimens which Dr. Drake-Brockman has promised to collect will probably decide this point. In this connection it may be pointed out that *A. Seyal*, which is stated to be the source of "habbak gurha" (p. 18), yields the "talh" gum of the Anglo-Egyptian Sudan, which is saleable in London, though at rather low prices under normal conditions.

Habbak jerin.—This gum is derived from a species of acacia not yet determined. It is stated to be of little or no value, and, when brought to the coast, is invariably found mixed with "habbak adad." It is only found in small quantities, in small, irregular, friable pieces varying in colour from a dull lemon-yellow to a sherry tint. It is eaten by the Somalis. The "jerin" tree is common on the maritime plain, known as Guban, and the higher lands, called Ogo-Guban. It seldom grows more than 3 or 4 ft. in height. The green seed-pods are eaten by the Somalis, as are also the roasted seeds.

The material received consisted of clear, long, irregular tears, varying in colour from pale to dark brown. The gum was not completely soluble in water. Such material, owing to its dark colour, would be difficult to sell in competition with gum of the same quality as the "habbak adad" described above.

Habbak sog-sog.—The "sog-sog" acacia has not yet been identified. The gum is always of a crimson or claret colour, and the pieces are irregular and seldom larger than a pigeon's egg. It is of no commercial value, but it is occasionally gathered by the nomad Somalis and eaten, being one of the few dark-coloured gums that are used in this way. The "sog-sog" tree is found both on the maritime hills and in the interior, where it grows best on stony ground and on the low, table-topped hills. It is a ragged tree, which grows to a height of 10 to 12 ft.

The sample received was stated to have been collected

on the Golis range and at Debbi in Ogo. It consisted of dark brown masses of agglomerated tears of gum, which, when treated with water, swelled to a gelatinous mass ("insoluble" gum). The gum represented by this sample would be of little or no commercial value on account of its dark colour and "insolubility."

Habbak gurha.—This gum, stated to be the product of *A. Seyal*, is of a dark port-wine colour when freshly exuded, but when old is almost black. It is seldom seen in lumps or pieces of any considerable size, but in elongated tears either on the trees or collected on the ground under the trees. The gum is not collected for export, and is only eaten by the Somalis when fresh. The "gurha" tree is the largest of the Somali acacias, and is most commonly seen on the banks of the larger rivers, where there is a more or less permanent subterranean source of water. In favourable localities it grows to a height of 25 to 30 ft. or more, and can be seen growing at its best on the river banks at Hargeisa, Burao, and Odweina.

The material received consisted of small pieces of dark-coloured and "burnt" gum of no commercial value (see, however, note on p. 17 as to the value of the gum yielded by *A. Seyal*).

Habbak giyato.—No information is available as to the source of this gum or as to the extent of its occurrence in Somaliland.

The specimen received was stated to have been obtained from a tree found on hills in Ogo. It consisted of one small tear of gum, which appeared to have become rather "burnt." It represented material of no commercial value.

Habbak harriri.—In this case also no information is available as to the botanical source of the gum. The sample examined was stated to have been obtained from Charabwim, near Obbia. It consisted of a few irregular tears of brown gum with much adherent bark.

Habbak obol.—The botanical source of this gum was not stated. The sample received was collected near Odweina, and consisted of conglomerated masses of elongated tears of very dark brown (almost black), glassy, transparent gum. Some bark was present. The sample

was soluble in water, but yielded a dirty purple-brown solution. The gum was too dark in colour to be of commercial value.

Gum-Resins

A number of products of this class find application in medicine or perfumery, e.g. myrrh, "opoponax," and frankincense or olibanum, and new gum-resins are as a rule of little commercial value unless they can be used as substitutes for products of this type already known in commerce, or possess some special property, such as fragrance, which will enable them to be used in perfumery or in preparing incense. The gum-resins from Somaliland now under report include samples of myrrh, frankincense, and "opoponax," as well as samples of "bdellium," all of which are more or less known in commerce. In all cases where the samples were large enough, the percentages of gum (matter soluble in water), resin (matter soluble in alcohol), and volatile oil (matter volatile in a current of steam) have been determined, and notes are recorded as to the character of these constituents. Where products known in commerce are concerned, the results of similar work already published on other samples are added for comparison, and commercial valuations by experts of the present samples are given.

Myrrh.—Two kinds of myrrh are found in Somaliland: "Ogo malmal," which is collected in the Haud, Nogal Valley, and Ogaden in the far interior, and "Guban malmal," collected in the low-lying, sun-parched coast regions and on the maritime hills. The first-named is of superior quality and is the "Turkey" myrrh of commerce. It fetches about double the price of "Guban malmal" on the local markets. The question of the botanical sources of the two varieties has not been definitely settled, but Dr. Drake-Brockman states that herbarium specimens of the coast and of the inland trees were both identified at Kew as *Balsamodendron Myrrha*, Nees, whilst both trees are known to the Somalis by the name of "didin." If the two varieties of myrrh are derived from one species, the differences exhibited by the two products must be

due to the different climatic conditions under which the trees grow. The "Ogo malmal" is found in irregular lumps, with a drier and more dusty appearance than the coast variety. The "Guban malmal" occurs in irregular masses made up of numberless "tears" or "drops," varying in size from that of a pin's head to that of a pea, the mass always having an oily appearance.

Samples of both varieties of myrrh were received for examination.

No. 1. *Myrrh* (*Ogo malmal*).—Large, irregularly shaped pieces of gum-resin, yellowish-brown and opaque externally, and brown and resinous internally. The fracture was brittle, oily, and irregular. The substance had the pleasant, fragrant odour and the bitter, nauseous taste characteristic of myrrh.

The sample yielded a deep red, transparent resin, which was almost tasteless, and a yellow, fragrant oil, which was mobile when freshly distilled but which changed rapidly on keeping to a stiff sticky substance of resinous appearance.

For the results of the chemical examination of this and some of the other gum-resins see table on p. 25.

No. 2. *Myrrh* (*Guban malmal*).—Brown irregular pieces of gum-resin, almost free from bark, and resembling the preceding sample No. 1 (Ogo malmal) in odour and taste. The sample yielded resin and oil similar in appearance to those obtained from No. 1. The oil from the present sample did not, however, become so stiff on keeping.

These two samples of myrrh approximated closely in character to commercial samples of "Aden" and "Somali" myrrh respectively, with which they were compared.

Habbak haddi.—This is the most important of all the Somali varieties of "bdellium" and is sometimes called "perfumed bdellium." According to Mr. E. M. Holmes, F.L.S., the tree yielding this gum-resin is *Commiphora erythræa* var. *glabrescens*, Engler. It is one of the largest of the desert trees and is found only in the western districts of Somaliland, especially in the Ogaden, Rer Amaden, and Aulihan countries. The gum-resin is known

to the Indian traders as "*Bissa bol*" and is exported to Bombay and from thence goes to China. It is invariably seen in large, irregular lumps of much the same colour as myrrh, except that small whitish areas are always present. It has a very powerful and distinctive odour, quite unlike that of myrrh, but is just as oily, if not more so, than Guban myrrh. Habbak haddi is the product now used in Europe as opoponax.

The specimen examined consisted of irregular pieces of semi-translucent gum-resin, varying in colour from light to dark brown and mottled with opaque yellowish matter. The pieces were hard and dry externally, but soft and oily internally.

The material possessed a strong, fragrant odour. It yielded a dark yellowish-red, transparent resin, which softened readily on warming. The volatile oil was a yellow, mobile liquid, which had a peculiar and fragrant smell, and did not resinify or turn dark on keeping.

Habbak hagar.—This is a somewhat rare "bdellium," sometimes found mixed with Guban myrrh. It is said to be derived from *C. Hildebrantii*, Engler. The tree is common on the maritime hills to the south of Berbera as far as the Golis range, and grows to a height of 10 to 12 ft. in suitable localities. The gum-resin resembles Guban myrrh in colour, but is less oily, and more brittle.

The sample examined consisted of very dark brown, semi-transparent, irregular pieces of gum-resin, together with some small pieces of a pale colour. The material had no marked odour, but possessed an intensely bitter taste. The sample was too small for detailed examination.

Habbak malo wa harod.—This closely resembles Guban myrrh, with which it is frequently found mixed. The tree, which has not yet been identified botanically, seldom exceeds 4 ft. in height, and when stunted resembles that yielding myrrh. It is found both at the coast and in the interior.

The specimen received consisted of two irregular tears of brownish gum-resin, possessing a very slight fragrance. It was too small for detailed examination.

Habbak daseino.—This is the product of *C. Opobalsamum*, Engler. The gum-resin is distinctly rare, and is never collected for export, although the tree is common enough, being found in the same localities as the myrrh ("didin") tree. The gum-resin is used by the Somalis for chewing, and also for burning in the huts to drive out flies, as in the case of frankincense, and for this reason is sometimes called by the same name as the latter, viz. "hanjibeyo."

One large tear of this gum-resin was received. It was dark brown in colour, and possessed an odour recalling that of elemi, but more fragrant. The sample was too small for detailed examination.

Habbak hodai.—This is the commonest of the opaque bdelliums. It is obtained from *C. Playfairii*, Hook., a tree common on the maritime mountains to the south and south-east of Berbera, as far as the Golis range, and in the Haud, Nogal Valley, and Ogaden; it grows to a height of 7 or 8 ft.

The gum-resin is found in irregular masses, which vary in size and colour according to their age: in the fresher or more recently exuded pieces the colour is a dirty milky white, but older pieces, which have been exposed to the weather, are of a dull reddish colour.

Two samples of this gum-resin were received.

No. 1.—Conglomerated masses of cream-coloured and brownish opaque gum-resin, which possessed a slight fragrance. A good deal of dirt, bark, etc., was present. The sample yielded a resin in the form of a cream-coloured mass, which did not melt below 100° C., but when heated with water gave an opalescent liquid. The resin was tasteless.

This sample contained no volatile oil, and would be classed as an "opaque bdellium."

No. 2.—Opaque, cream-coloured tears, small, opaque chips, and irregular, conglomerated masses of cream-coloured and brown gum-resin, which possessed a slight fragrance, and closely resembled the preceding sample of "Habbak hodai (opaque bdellium)." Some bark was present.

The material yielded a resin similar to that given by the preceding sample, and also contained no volatile oil.

Habbak dunkal.—This bdellium is very rare, being only sparingly found on the "dunkal" tree, the botanical identity of which has not yet been established. The tree is always found on rocky ground, such as the maritime mountains, and seldom exceeds 4 to 5 ft. in height. The gum-resin, which is said by the Somalis to be very poisonous, possesses a hard and usually roughened and cracked exterior, whilst the interior is opaque, dull, and yellowish-red, not unlike beeswax; when thoroughly dry it becomes very hard.

The specimen examined consisted of small, buff-coloured, opaque tears of gum-resin, with a rough surface, mixed with irregular, dark brown, opaque fragments of gum-resin. A few pieces of bark were present.

The sample yielded a yellowish-brown, transparent resin with a somewhat bitter taste, and contained no volatile oil. It resembled in appearance the samples of "habbak hodai" examined, and would probably be classed as an "opaque bdellium."

Frankincense.—Two varieties of frankincense are exported from Somaliland, viz. "Loban maidi" and "Loban dakar." The former is obtained from the "yehar" tree (*Boswellia Frereana*, Birdw.), which is commoner in the Warsangeli and Mijertain regions than elsewhere, but is sparingly found in the Habr Toljaala country. "Loban dakar" is derived from the "mohor" tree (*B. Carteri*, Birdw.), which is found only on maritime hills and mountains in the Habr Toljaala, Warsangeli, and Mijertain countries. "Loban maidi" is always of a pale topaz-yellow colour; it occurs in tears or in large, flat, irregular pieces, showing white, powdery streaks, and is very apt to stick together when tightly packed. The other variety of frankincense (Loban dakar) is always found in separate small tears, which seldom agglomerate when packed in bags. Both varieties, as collected by the natives, are mixed with foreign matter, and they are usually cleaned in Aden, the picked samples of "Loban maidi" going mostly to India and Egypt, whilst those of "Loban dakar" are sent

to Europe. The inferior qualities of each kind are shipped back to Africa, most of it finding its way to Abyssinia.

Samples of both varieties of frankincense were received for examination.

No. 1. *Loban maidi*, 1*st quality*.—Irregular lumps of straw-coloured gum-resin, with an opaque coating but transparent internally, and possessing a pleasant terebinthous odour. The fracture was friable and resinous. Some of the lumps had thin, buff-coloured stems running through the gum-resin, while other lumps had thin, papery, buff-coloured bark attached to them.

The sample yielded a light brown, brittle, glassy, tasteless resin, and a yellow, mobile, volatile oil with a fragrant terebinthous odour. The oil contained no phellandrene. It had the following constants:

Specific gravity at $\frac{15^\circ C.}{15^\circ C.}$	0·859
Refractive index at 23° C.	1·464
Specific optical rotation $[\alpha]_D^{15}$	+ 11° 50′

This material closely resembled the "Luban mayeti" described by Flückiger and Hanbury (*Pharmacographia*, p. 153), which is said to be derived from *B. Frereana*. It contained very little gum, and had a lower acid number and saponification number than "Loban dakar" (see table, p. 25).

No. 2. *Loban dakar*, 1*st quality*.—Tears and masses of pale buff-coloured, semi-opaque, brittle gum-resin, possessing a sweet smell and a slight taste. The sample yielded a yellowish-brown, transparent, tasteless resin, and a yellow, mobile, volatile oil which had a terebinthous odour, and which did not thicken on keeping. The quantity of oil obtainable was insufficient for examination.

The results of the analyses of eight of the foregoing samples of gum-resin are given in the following table. The samples of "habbak hagar," "habbak malo wa harod," and "habbak daseino" were too small for detailed examination. The corresponding figures for samples of "Aden" and "Somali" myrrh and of frankincense (olibanum) are added for comparison:

Results of Chemical Examination

	Myrrh I. Ogo malmal.	Myrrh II. Guban malmal.	Commercial myrrh, Aden type.	Commercial myrrh, Somali type.	Habbak haddi.	Habbak hodai (1).	Habbak hodai (2).	Habbak dunkal.	Frankincense. Loban maidi.	Frankincense. Loban dakar.	Commercial frankincense (olibanum).
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture . .	10·2	10·5	8·9	12·9	22·2	8·1	8·9	5·3	5·2	10·5	8·1
Ash . . .	3·0	5·2	18·0	4·4	2·8	12·8	6·5	2·4	0·6	1·2	1·3
Volatile oil . .	13·8	11·8	(not determined)		10·6	nil	nil	nil	5·3	2·8	(not determined)
Resin, soluble in alcohol . .	31·7	29·7	31·0	22·3	41·4	59·9	65·1	64·6	88·9	61·6	66·9
Matter insoluble in alcohol . .	54·5	58·5	60·1	64·8	36·4	32·0	26·0	30·1	5·8	27·9	25·0
Consisting of:											
Matter soluble in water (gum) .	52·1	56·8	36·2	58·6	20·9	17·7	17·7	26·0	3·1	23·4	21·2
Matter insoluble in water (chiefly dirt)	2·4	1·7	23·9	6·2	15·5	14·3	8·3	4·1	2·7	4·5	3·8
Acid number . .	26·5	17·8	19·0	40·5	29·5	23·6	26·9	13·0	5·0	23·6	36·0
Saponification number . .	143·0	130·0	97·0	120·0	111·0	58·0	59·0	164·0	23·0	60·0	102·0

Commercial Valuation of the Gum-Resins

Seven of the foregoing samples of gum-resin were submitted to a firm of London brokers, who valued them in March 1913 as follows:

Myrrh (*Ogo malmal*).—The brokers stated that this sample contained some fine-quality myrrh worth fully £5 per cwt., but they classed the remainder as "common drossy," and considered that on account of this the average value of the sample would be about 55*s.* to 60*s.* per cwt. in London.

Myrrh (*Guban malmal*).—Of good quality, and worth about 60*s.* to 65*s.* per cwt.

Habbak haddi.—The brokers classed this as "bdellium," and regarded it as of fair quality and nominally worth about 6*d.* to 8*d.* per lb.

"Habbak haddi" is the material now used in commerce as a source of opoponax oil. A sample of the "habbak haddi" gum-resin was therefore also submitted to a firm of essential oil distillers, who reported that the oil distilled from the material showed approximately the constants established for the pure oil of opoponax of commerce. They stated that it was difficult to give a reliable valuation

of the resin, as prices vary according to the appearance, the yield of oil, and the aroma of the material. They considered, however, that a price of from 60*s.* to 75*s.* per cwt. c.i.f. London (February 1913) would represent a fair average value. It will be seen that this range of prices is much the same as that of the value "6*d.* to 8*d.* per lb." assigned to the gum-resin by the firm of brokers to whom it was submitted in London.

Habbak hodai (*opaque bdellium*).—Of no value on the London market.

Frankincense (*Loban maidi*).—The brokers classed this as "thus," and stated that it would be saleable in small quantities at 25*s.* per cwt.

Frankincense (*Loban dakar*).—This was classed as "olibanum, fair greenish drop," and was valued at 35*s.* per cwt.

Resins

Hanjikulan.—This resin is said to be obtained from an undetermined species of Balanites which is common in the maritime region to the south and south-west of Bulhar. The resin is not collected for export, but is used for chewing. The products of two other species of Balanites, viz. "hanjigoad" from *B. orbicularis* and "hanjikidthi" from *B. ægyptiaca*, are also collected. These three resins are difficult to distinguish, as they possess a similar odour and all are found in tears or globular pieces varying in size from that of a cherry to that of a pigeon's egg, the smaller ones being of a dark greenish-yellow colour, while the larger pieces are deep orange-red.

The sample of "hanjikulan" received consisted of tears and masses of tears of greenish-brown, friable, transparent resin, with a pleasant but not very strong odour. The ground resin turned dark green on exposure to light. On analysis the resin gave the following results:

	Per cent.
Moisture	3·6
Ash	0·3
Volatile oil	6·0
Resin, soluble in alcohol	96·0
Matter insoluble in alcohol	trace
Acid number	24·7
Saponification number	64·0

The resin soluble in alcohol was yellowish-brown, transparent, and practically tasteless. The volatile oil was yellow and mobile when freshly distilled, but thickened on keeping; it had a fragrant and rather pungent odour.

This resin is unknown in European markets, and consequently has no commercial value at present. It possesses certain interesting chemical properties, and a detailed examination of it will be made when opportunity offers.

GUMS FROM NORTHERN NIGERIA

In previous numbers of this Bulletin (1908, **6**, 47; 1910, **8**, 353), an account has been given of the gum industry of Northern Nigeria, together with the results of examination at the Imperial Institute of a series of gums derived from various species of acacia from that country. In the following pages the gums of two species of acacia are dealt with, viz. *Acacia campylacantha*, Hochst., and *A. Sieberiana*, DC., as well as a consignment of "Kol-kol" gum (*A. Senegal*, Willd.), which was forwarded to the Imperial Institute for sale in London.

"*Golawai*" *gum* (*A. campylacantha*, Hochst.). Three samples of this gum from the Bornu Province were received in February 1912.

Grade A consisted of glassy gum varying in colour from pale straw to reddish-brown. A small quantity of dirt (fragments of leaves and bark) was present.

Grade B closely resembled the preceding, but contained fewer dark coloured pieces of gum.

Grade C closely resembled B, but consisted of smaller fragments and was rather paler in colour.

All three gums gave a pale yellow mucilage possessing good adhesive properties. They were examined, with the following results:

	Grade A.	Grade B.	Grade C.
Moisture . . . . *per cent.*	10·6	10·7	10·6
Ash . . . . *per cent.*	3·6	3·4	3·4
Matter insoluble in water, *per cent.*	1·2	1·1	2·2
Acid number[1]	2·5	2·2	1·9
Relative viscosity of a 10 per cent. solution at 22° C.[2] . . .	11·7	13·1	8·8

[1] *Milligrams of potassium hydroxide required to neutralise* 1 *gram of gum.*

[2] *As compared with* 1 *for water, determined under the same conditions.*

"Golawai" gum, as represented by these three samples, would be classified commercially as "semi-insoluble" gum, and would be worth from 15*s.* to 17*s.* 6*d.* per cwt. when saleable. There is, however, little demand for such gum as long as typical soluble gums, such as the "kol-kol" (*A. Senegal*, Willd.) and "karumga" (*A. Seyal*, Del.) gums are obtainable in quantity at cheap rates.

"*Katalabu*" *gum* (*A. Sieberiana*, DC.)—Two samples of this gum, Grades A and B, from the Bornu Province, were received at the same time as the samples of "golawai" gum. Both consisted of glassy gum varying in colour from straw to reddish-brown, but on the whole darker than the "golawai" gums described on page 27. A small quantity of bark was present in Grade A.

The results of examination of the two grades of "katalabu" gum are shown in the following table:

		Grade A.	Grade B.
Moisture	*per cent.*	10·3	10·2
Ash	*per cent.*	2·3	2·1
Matter insoluble in water	*per cent.*	1·8	1·3
Acid number		3·9	4·4
Relative viscosity of a 10 per cent. solution at 22° C.		4·7	5·7

Both samples gave a yellowish-brown mucilage possessing good adhesive properties.

These results show that this variety of gum is of promising quality. Both samples were valued by brokers at 22*s.* 6*d.* to 24*s.* per cwt., with "glassy Khartum" gum at 31*s.* per cwt. (April 1913).

General Conclusions

Herbarium specimens of the four kinds of gum trees said to exist in Northern Bornu, and samples of the gums yielded by them, have now been received at the Imperial Institute and examined. "Karumga" and "kol-kol" gums were dealt with in a report published in this BULLETIN (1910, **8**, 352) and "golawai" and "katalabu" gums in the present report. The results of this work may be briefly summarised as follows:

Native name of tree.	Scientific name.	Nature of gum.	Commercial value of gum.
"Karumga"	*A. Seyal*, Del.	Soluble	19*s.* to 30*s.* per cwt. according to grade (January 1910).
"Kol-kol"	*A. Senegal*, Willd.	Soluble	24*s.* to 28*s.* per cwt. according to grade (January 1910).
"Golawai"	*A. campylacantha*, Hochst.	Semi-insoluble	15*s.* to 17*s.* 6*d.* per cwt. (April 1913).
"Katalabu"	*A. Sieberiana*, DC.	Soluble	22*s.* 6*d.* to 24*s.* per cwt. (April 1913).

These results show that although good prices can be obtained for selected gum from the "karumga" tree, (*A. Seyal*), the best gum-yielding species in Northern Nigeria, as in the Sudan and Senegal, is "kol-kol" (*A. Senegal*). In collecting gum for export it is very important that inferior gum such as that yielded by "golawai" (*A. campylacantha*) should not be mixed with the better qualities of gum, such as that furnished by "kol-kol" trees, or those obtained from "karumga" or "katalabu" trees.

With regard to the samples of all these gums forwarded to the Imperial Institute, it may be pointed out that better prices are obtained for consignments of gum where these consist of pieces which are uniform in size and colour and are free from dust, and that it is not worth while attempting to divide gum into grades unless these points are attended to. Thus none of the so-called "grades" of gum dealt with in this or the previous report would be regarded as distinct grades in the United Kingdom, since they all consisted of gum varying in colour and flavour and in size of pieces.

In a report by Mr. Beckles Gall, Acting Resident, Bornu, sent to the Imperial Institute in 1908, two other trees which yield a kind of gum are mentioned, viz. "kingur" and "kindil." Herbarium specimens of both these trees were forwarded with the series of samples now under report. The specimen representing "kingur" was incomplete and could not be identified, and a further herbarium specimen of the tree has been asked for. "Kindil" was identified at the Royal Botanic Gardens, Kew, from the herbarium specimen submitted, as *A. Seyal*, Del., which would make it identical with "karumga" (*loc. cit.*

p. 357). It seems clear, from Mr. Beckles Gall's statement already mentioned, that "karumga" and "kindil" are distinct species, and a further herbarium specimen of each of these two trees has been requested in order that this discrepancy may be cleared up. A sample of "kindil" gum has also been requested for examination. A sample of "kingur" gum was forwarded with the series of samples now dealt with, but this proved to be a mixture of products, which cannot all have been obtained from the same species of tree. It has been suggested, therefore, that a further sample of this gum from authenticated "kingur" trees should be collected and forwarded for examination.

Commercial Consignment of "Kol-kol" Gum

The consignment of "kol-kol" gum, derived from *A. Senegal*, Willd., which is the subject of this report, weighed about 13 cwt., and was received at the Imperial Institute in July 1913.

The consignment, as received at the Imperial Institute, consisted of three grades of gum, contained in forty cases. The inner bags in which most of the gum had been packed were found to have been injured in transit, with the result that the outer packing, consisting of seed-cotton and straw, had become mixed with the gum; and it was necessary to clean the gum at the Imperial Institute before it could be analysed or sold.

The three grades of gum after cleaning were as follows:

Grade I.—This sample consisted of tears, broken tears, and fragments of clean gum, varying from nearly colourless to light brown, but on the whole pale in colour. The gum was mostly of the "glassy" type, with a small admixture of opaque gum.

This gum resembled a sample of "kol-kol large grade" gum previously examined at the Imperial Institute (this Bulletin, 1910, **8**, 357), but was somewhat darker in colour. It was completely soluble in water. The resulting mucilage was of pale straw colour, and possessed good adhesive properties.

Grade II.—Clean gum, similar in appearance to Grade I, but in smaller fragments, of paler colour and containing

more opaque gum. It closely resembled the sample of "kol-kol medium grade" gum previously examined at the Imperial Institute (*loc. cit.*).

This gum was completely soluble in water. The resulting mucilage was of pale straw colour, and possessed good adhesive properties.

Grade III.—This consisted mostly of fragments and dust of pale-coloured gum, and resembled the sample of "kol-kol small grade" gum previously examined at the Imperial Institute (*loc. cit.*).

The gum was completely soluble in water. The mucilage was of pale straw colour, and possessed good adhesive properties.

Samples of the three grades were analysed at the Imperial Institute with the following results:

	Grade I.	Grade II.	Grade III.
Moisture . . . . *per cent.*	13·3	13·5	13·1
Ash . . . . . *per cent.*	3·3	3·3	3·5
Matter insoluble in water . *per cent.*	0·1	0·2	0·4
Acid number	3·2	3·3	3·2
Specific rotation in water . . .	-26° 20′ at 20° C.	-26° 50′ at 20° C.	-26° 10′ at 21° C.
Relative viscosity of a 10 per cent. solution at 22° C.	6·2	6·4	6·4
Specific gravity of a 10 per cent. solution at $\frac{15^{\circ}\text{ C.}}{15^{\circ}\text{ C.}}$	1·035	1·036	1·037

The gum, after cleaning, was submitted to a firm of merchants in London, who purchased the three grades in one lot on December 19, 1913, at the price of 30*s.* per cwt., less 2½ per cent. discount.

The merchants reported that the gum was of very desirable quality, closely resembling Kordofan gum in appearance, although rather darker in solution, and that it should be useful for all purposes for which Kordofan gum is employed. They added that Grades II and III had perhaps been partially bleached in the sun. It is clear from these results that Nigerian "kol-kol" gum, carefully collected and prepared for the market, will realise good prices in London.

FIBRES FROM VARIOUS SOURCES

In the following pages an account is given of the results of examination of a number of fibres received at the Imperial Institute in recent years, the materials being arranged according to their industrial uses.

Fibres Suitable for Coarse Textiles

Jute from India

The four samples of jute dealt with in this report were received in July 1912. They were grown on experimental plots at Dacca, Bengal, and were examined chiefly with a view to determining the relation between the strength of the fibres and their chemical properties, especially the loss on hydrolysis and the percentage of cellulose.

No. 1.—Clean, fine, buff-coloured fibre of good lustre. It was of very good strength and varied in length from 4 ft. 7 in. to 5 ft. 5 in., with an average of 5 ft. 1 in. This appeared to be the best of the four samples.

No. 2.—Buff-coloured fibre, of good lustre, soft and clean, except for occasional gummy portions at the root ends. It was rather weaker than the preceding sample. The length varied from 4 ft. 2 in. to 5 ft. 9 in., with an average of 5 ft.

No. 3.—Buff-coloured fibre, not so lustrous as sample No. 2. It was of uneven strength, being rather poor on the whole, and varied in length from 4 ft. 6 in. to 6 ft. 8 in., with an average of 6 ft. 2 in.

This jute was somewhat inferior to samples 1, 2, and 4.

No. 4.—Buff-coloured fibre of good lustre. It was of good strength, and varied in length from 5 ft. 6 in. to 6 ft. 8 in., with an average of 5 ft. 10 in. This sample appeared to be rather inferior to No. 1, but superior to Nos. 2 and 3.

The chemical examination of these fibres gave the following results, which are compared with those given by "extra fine" Indian jute.

	No. 1.	No. 2.	No. 3.	No. 4.	"Extra fine" Indian jute.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture . . .	11·7	11·5	11·4	12·45	9·6
Ash	0·52	0·84	0·69	0·65	0·7
α-Hydrolysis, loss .	7·6	7·9	8·9	8·0	9·1
β-Hydrolysis, loss .	11·3	12·2	13·1	12·3	13·1
Cellulose . . .	78·4	76·4	75·2	77·6	77·7
Length of ultimate fibres.	From 0·06 to 0·14 in.; average, 0·096 in.	From 0·08 to 0·12 in.; average, 0·092 in.	From 0·06 to 0·16 in.; average, 0·088 in.	From 0·06 to 0·12 in.; average, 0·092 in.	From 0·06 to 0·12 in.

Attempts were made to determine the breaking stress of these fibres by means of a testing machine, but the experiments had to be abandoned as it was found that no useful or trustworthy results could be obtained in this way, on account of the peculiar nature of the fibre. It was impossible, for example, to obtain single filaments suitable for the test, owing to the fact that the filaments are not continuous, but may be split up into two or more finer strands at various points in their length.

A comparison of the tensile strength of the fibres was therefore effected by hand, and it was found that No. 1 was the strongest, followed by the others in the order 4, 2, 3. In the following table, the samples are arranged in this order, and the losses sustained on hydrolysis and the percentages of cellulose are compared:

	α-Hydrolysis, loss *per cent.*	β-Hydrolysis, loss *per cent.*	Cellulose, *per cent.*
No. 1 . . .	7·6	11·3	78·4
No. 4 . . .	8·0	12·3	77·6
No. 2 . . .	7·9	12·2	76·4
No. 3 . . .	8·9	13·1	75·2

An examination of this table shows that the strength is closely related to the percentage of cellulose and also to the hydrolysis constants.

The length of the ultimate fibres of these samples was quite normal in each case, the range previously recorded for jute being from 0·06 to 0·12 in.

Malachra capitata *Fibre from India*

Two samples of this fibre have been received, the first in August 1909 and the second in November 1912.

No. 1.—Nearly white, lustrous fibre, fairly well cleaned, but containing patches of barky matter. The root ends were uncut. The fibre was of good strength, with an average length of 6 ft.

No. 2.—Fairly soft, very lustrous, almost white fibre, well cleaned and prepared, but rough and coarse at the root ends. It was rather uneven in strength, ranging from fair to weak. The length varied from 7 to 8 ft.

The results of examination of these two fibres are shown in the following table, together with the figures obtained for a sample previously examined at the Imperial Institute (see *Technical Reports and Scientific Papers*, 1903, p. 68).

	No. 1.	No. 2.	Previous samples.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	11·1	10·8	12·5
Ash	0·8	0·4	1·0
α-Hydrolysis, loss	10·0	9·7	12·3
β-Hydrolysis, loss	15·0	13·3	17·8
Acid purification, loss	0·9	0·4	2·6
Cellulose	74·4	75·1	74·2
Length of ultimate fibres	—	From 0·06 in. to 0·1 in.; average, 0·08 in.	—

The fibre represented by these samples would be readily saleable in the United Kingdom as a substitute for ordinary jute. Sample No. 1 was valued at £13 per ton with "first native marks" Calcutta jute at £15 per ton (November 1909), but if it had been better cleaned and the root ends cut off the value would have been increased to about £16 or £17 per ton. Sample No. 2 was valued at £30 per ton in London, with "first marks" Calcutta jute at £26 5*s.* to £26 10*s.* per ton (February 1913) and in this case also the value would have been increased if a few inches of the root ends had been cut off. The merchants who valued the second sample stated that they would be glad to receive shipments of the fibre for sale in London.

Urena lobata *Fibre from India*

A sample of *Urena lobata* fibre from India was received in November 1912. It consisted of fairly soft, cream-coloured fibre, of good lustre. The sample was well

cleaned and prepared, but rough and coarse at the root ends. The strength was rather uneven, but fair on the whole. The length varied from 7 ft. to 9 ft., with an average of 8 ft.

The fibre was examined with the following results:

	Per cent.
Moisture	10·6
Ash	0·3
α-Hydrolysis, loss	9·4
β-Hydrolysis, loss	13·4
Acid purification, loss	1·1
Cellulose	77·5
Length of ultimate fibres	From 0·06 to 0·16 in.; average 0·09 in.

This fibre was of good spinning quality, and could be spun in conjunction with the finest grades of Calcutta jute. The sample was valued by merchants at £35 per ton in London, with "first marks" Calcutta jute at £26 5s. to £26 10s. per ton (February 1913).

A small consignment of *U. lobata* fibre, weighing 5¼ cwts., was received in March 1913. It consisted of fairly soft, fine, lustrous fibre, varying in colour, but chiefly of a cream tint, with a greenish or brownish tinge in parts. The fibre was fairly well cleaned and prepared up to about 1 ft. from the root ends; the latter were of a greyish colour, and contained many pieces of closely adherent bark. The strength of the fibre was rather uneven, varying from fair to rather weak. The length of staple varied from 4 ft. to 6 ft. 8 in., but was mostly between 5 and 6 ft.

This fibre was of about equal strength and lustre to the previous sample of *U. lobata* fibre, but it was not so regular in colour nor so well cleaned and prepared; it was also of shorter staple.

About 6 in. of the root ends of this fibre should be cut off, and baled separately for shipment. If this were done the rest of the fibre would be enhanced in value, whilst the root ends would find a market for paper making.

The consignment was sold in London, together with the second consignment of Sida fibre referred to below (see p. 36), at the rate of £36 per ton. On the date of the sale "first native marks" Calcutta jute was quoted at £35 10s. to £36 per ton. For an account of the spinning qualities of this fibre, see p. 37.

Sida Fibre from India

A description of this Indian fibre has already been given in this BULLETIN (1912, **10**, 218). Since that date two small consignments have been received at the Imperial Institute for sale.

No. 1.—This consisted of a bale of fibre and was received in April 1912. It was placed for disposal with a firm of merchants in London, who described the fibre as fine and soft and of very bright white colour, similar to fine white jute, but rather weaker. The full value of the fibre was estimated to be £28 to £30 per ton in London, but they pointed out that it is always difficult to get buyers to pay the full value for sample bales of fibre, and that consequently a lower price would probably have to be accepted. It was ultimately sold at the rate of £27 per ton.

No. 2.—This consignment, weighing about 5¼ cwts., was received in March 1913. It consisted of fine, soft, lustrous fibre, varying in colour from pale brownish-yellow to pale straw. The material was fairly well cleaned and prepared, but it still contained many pieces of closely adherent bark. The length of the staple varied from 3 to 6 ft., but was mostly from 5 to 6 ft. The strength was fairly good.

Compared with a previous sample of Sida fibre from India (*loc. cit.*), the present sample was of somewhat better strength and of equal lustre, but its colour was not so regular, and it was not so well cleaned and prepared. It was also shorter, the previous sample having been from 6 to 8 ft. long.

This consignment of Sida fibre was sent for sale to a firm of merchants in London, who valued it at from £32 to £33 per ton, but stated that if properly cleaned and prepared it would realise £40 per ton in London (August 18, 1913).

The fibre was ultimately sold, together with the consignment of *Urena lobata* fibre (see p. 35), at the rate of £36 per ton. On the date of sale "first native marks" Calcutta jute was quoted at £35 10s. to £36 per ton.

The spinners who purchased the Sida and Urena fibres reported that they spun very well. One firm stated that no

trouble whatever was experienced in their trials with the material, and that it can be mixed with other fibres. A second spinner reported that the fibre did not spin quite so well as Bengal jute, as it was liable to run into small places, giving a weaker yarn, so that the yarn would probably only be suitable for weft.

As the two fibres were sold and spun together, it was not possible to state which of them alone would give the better results, but presumably they are about equal in spinning quality.

The merchants stated that these Sida and Urena fibres are the nearest substitute for Bengal jute that has ever come into the market, and that spinners would welcome supplies from India. They considered that the fibres should be readily saleable at a fraction under the price of "first marks" Calcutta jute, and anticipated that if some sacrifice in the price were made at first in order to get them introduced on the market, they would eventually bring a higher price than "first marks" jute, provided that the quality was equal to that of the present trial consignments.

Fibre from Southern Nigeria

A sample consisting of two bundles of clean, fairly lustrous, pale straw-coloured ribbons of bast fibre was received in December 1911. The individual strands were closely interlaced, and frequently broke at the junctions when any attempt was made to separate them. As received, the ribbons measured from 5 to 6 ft. in length, but on combing they were reduced to strands varying in length from under 1 ft. to 4 ft. The strength of the fibre was mostly good, but rather uneven.

The fibre was examined with the following results, compared with those given by a sample of "Kowe" fibre from Sierra Leone and "extra fine" Indian jute:

	Present sample. *Per cent.*	"Kowe" fibre from Sierra Leone. *Per cent.*	"Extra fine" Indian jute. *Per cent.*
Moisture	10·1	11·5	9·6
Ash	0·5	0·2	0·7
α-Hydrolysis, loss	8·2	6·0	9·1
β-Hydrolysis, loss	13·2	8·5	13·1
Acid purification, loss	0·5	0·2	2·0
Cellulose	78·7	78·0	77·7

The sample was valued nominally at from £19 to £21 per ton, with China jute at £17 to £19 per ton (March 1912).

This fibre was very similar to jute in chemical behaviour, as is evident from a comparison of the figures obtained on chemical examination with those furnished by a sample of "extra fine" Indian jute; it was, however, harsher and not so lustrous as jute. It closely resembled in appearance "Kowe" fibre (*Hibiscus quinquelobus*) from Sierra Leone, and was very similar to it in chemical behaviour, although more susceptible to the action of hot dilute alkali (α- and β-hydrolysis).

The fibre was probably derived from a species of *Hibiscus*. It was coarser than jute, and possessed the disadvantage of the interlacing character, which, as already stated, caused the fibre to break up when combed. In these respects it closely resembled "Kowe" fibre.

In connection with the nominal price quoted for the fibre, it may be mentioned that there has been considerable variation between the valuations of samples of "Kowe" fibre by commercial experts, and the prices realised at the sale of small consignments, these variations depending on fluctuations in the market prices of jute and Manila hemp. "Kowe" and similar fibres can be spun with jute, but they are not very satisfactory for this purpose, and will therefore only be purchased by jute-spinners when very high prices are ruling for the latter fibre. They can also be utilised by rope-makers when Manila hemp is very dear.

Rama Fibre from Northern Nigeria

"Rama" fibre is produced in Northern Nigeria from the stems of *Hibiscus lunariifolius*. It is reported that an increasing quantity is now being shipped to the United Kingdom.

Two samples of this fibre from Northern Nigeria have been examined at the Imperial Institute.

No. 1.—Brownish-white fibre, on the whole well cleaned, but in parts very gummy and badly cleaned; it possessed a good lustre, but was too harsh for a jute substitute. It was

of good strength, and varied in length mostly from 4 to 7 ft., but some was only 3 ft. long.

No. 2.—Well-cleaned, jute-like fibre of good lustre, and mostly of a pale straw colour, with some portions, especially the root ends, buff-coloured. It was of good strength, with an average length of about 8 ft.

The samples were examined with the following results, as compared with those given by "extra fine" Indian jute:

	No. 1.	No. 2.	"Extra fine" Indian jute
	Per cent.	*Per cent.*	*Per cent.*
Moisture	8·5	10·5	9·6
Ash	0·4	0·8	0·7
α-Hydrolysis, loss . .	7·4	9·5	9·1
β-Hydrolysis, loss . .	10·2	12·8	13·1
Acid purification, loss . .	0·4	1·1	2·0
Cellulose	76·8	77·0	77·7

Sample No. 1 was valued at £12 per ton, with "common" jute at £11 to £12 per ton (May 1909), while No. 2 was regarded as worth £16 to £17 per ton as a jute substitute, with "first native marks" at £14 7*s.* 6*d.* per ton (February 1910).

The results of examination of these fibres compared above with those for "extra fine" Indian jute, show that the three samples closely resemble one another in chemical composition and behaviour. Sample No. 2 was less harsh than the No. 1, and could be used as a substitute for jute. It would be readily saleable in the United Kingdom.

Cordage Fibres

Sisal Hemp from the Federated Malay States

A considerable number of samples of Sisal hemp from various countries have been examined at the Imperial Institute, and the results of examination of some of these have been published in previous numbers of this Bulletin. Among these may be mentioned samples from Rhodesia (1904, **2**, 168), Sierra Leone (1907, **5**, 107), East Africa Protectorate, Uganda, and Nyasaland (1909, **7**, 160), Portuguese East Africa (1912, **10**, 131), Mauritius (1910, **8**, 9), India (1906, **4**, 25; 1909, **7**, 11; 1912, **10**, 216), and Papua (1912, **10**, 214).

The sample of Sisal hemp which is the subject of the present report was received at the Imperial Institute in

September 1913. It was desired that the fibre should be examined and valued, and that its tensile strength, in particular, should be determined.

The sample consisted of lustrous fibre, fairly well cleaned and prepared, but of slightly uneven colour, varying from cream to brownish-yellow, and generally considerably darker in tint than is usually the case with Sisal hemp. The length of staple varied from 2 ft. 8 in. to 6 ft., with an average of 4 ft. 3 in.

The fibre was submitted to chemical examination with the following results, compared with corresponding figures for a sample of Sisal hemp from the East Africa Protectorate:

	Present sample. *Per cent.*	Sisal hemp from the East Africa Protectorate. *Per cent.*
Moisture	12·0	11·1
Ash	0·8	1·0
α-Hydrolysis, loss	11·3	11·2
β-Hydrolysis, loss	20·1	14·1
Acid purification, loss	1·9	2·3
Cellulose	77·1	78·2

The length of the ultimate fibres varied from 0·06 to 0·29 in., with an average of 0·19 in.

The dark colour of the fibre as received at the Imperial Institute was found to be due to the presence of iron, which may have been derived either from the water used in washing or from the scraping instruments used in preparing the fibre. After removing this iron by the use of chemicals, the washed and dried fibre was of a light cream colour.

The fibre was also examined for tensile strength and elongation in comparison with a standard sample of Sisal hemp from East Africa. Using a length of 20 cm. of fibre for the tests, the following average results were obtained:

	Present sample.	Sisal hemp from East Africa.
Breaking stress in grams	618	1,102
Extension before breaking, *per cent.*	4·5	2·0

Taking the East African Sisal hemp as the standard, the ratios are as follows:

	Present sample.	Sisal hemp from East Africa.
Breaking stress	56	100
Extension	225	100

The above figures indicate that the present sample has only 56 per cent. of the strength of the East African Sisal hemp, but that it is $2\frac{1}{4}$ times as extensible as the latter.

The fibre was submitted to a firm of merchants, who valued it at £25 per ton in London, with Mexican Sisal at £26 per ton (December 1913).

Fibre of this quality would be saleable in large quantities for cordage manufacture. A more valuable product could probably be obtained by extracting the leaves with modern machinery and brushing the fibre produced.

Aloe Fibre from Bechuanaland

A sample of fibre thought to be derived possibly from *Aloe Lugardiana* was received in October 1913. It consisted of lustrous, fairly fine, soft fibre, of pale straw colour, and well cleaned and prepared. It was of fairly good strength, and varied in length from 1 ft. $8\frac{1}{2}$ in. to 3 ft. $1\frac{1}{2}$ in., but was mostly about 2 ft. 6 in.

It was examined with the following results, which are compared with those given by Sisal hemp from the East Africa Protectorate.

	Present sample. *Per cent.*	Sisal hemp from East Africa. *Per cent.*
Moisture	10·6	11·1
Ash	1·4	1·0
α-Hydrolysis, loss	14·3	11·2
β-Hydrolysis, loss	17·9	14·1
Acid purification, loss	5·6	2·3
Cellulose	71·6	78·2
Length of ultimate fibres	From 0·03 to 0·14 in.; average, 0·07 in.	From 0·04 to 0·16 in.; average, 0·10 in.

This fibre was valued at £27 to £28 per ton in London (December 1913). It was of very good appearance and of fairly good strength, and would probably be saleable in the United Kingdom as a cordage material, although it is rather short for this purpose. The low percentage of cellulose and the rather high loss on hydrolysis indicate that the fibre was somewhat inferior to Sisal hemp in respect of chemical composition and behaviour, and that it would probably prove to be less durable.

"Crowa" Fibre from British Guiana

A sample of "Crowa" fibre was received from British Guiana in March 1909. The exact botanical source of the fibre was not known, but it was stated to be derived from a Bromeliad and possibly a species of *Ananas* or *Karratas*.

The fibre was fine, very pale straw-coloured, without much lustre, but very well cleaned. The strength was somewhat uneven, but on the whole was very good. The length varied from 4 ft. to 5 ft. 6 in.

On examination the fibre gave the following results compared with those yielded by pineapple fibre from the Gold Coast.

	"Crowa" fibre. *Per cent.*	Pineapple fibre from the Gold Coast. *Per cent.*
Moisture	9·9	9·5
Ash	0·6	1·1
α-Hydrolysis, loss	12·3	13·7
β-Hydrolysis, loss	16·1	19·4
Acid purification, loss	1·8	1·7
Cellulose	84·1	81·5
Length of ultimate fibres	From 0·20 to 0·44 in., with an average of 0·28 to 0·32 in.	—

This fibre is suitable for rope making and would be readily saleable on the London market. It was valued at £24 per ton (October 1909).

The results of the chemical examination show that this "Crowa" fibre is superior to the sample of pineapple fibre (*Ananas sativus*) from the Gold Coast, since it contains a larger proportion of cellulose and suffers a smaller loss on boiling with dilute alkali (α- and β-hydrolysis). It is probable, therefore, that the "Crowa" fibre would be very durable and able to resist the prolonged action of water.

Paper Making Materials

Nipa Palm Leaves from Sarawak

The results of examination of Nipa palm petioles and fibre from the Federated Malay States, as paper making materials, have already been published in this Bulletin (1912, **10**, 376).

In July 1913 the following samples were received for examination from Sarawak.

No. 1. "*Stem of Nipa Palm.*"—This was apparently a portion not of the stem, but of the midrib of a leaf. It measured 15½ in. in length and about 1½ in. in diameter.

No. 2. "*Old leaves of Nipa Palm.*"—The sample consisted of three "leaves" (pinnæ) measuring from 5 ft. to 5 ft. 10 in. in length and from 4 to 4¼ in. across at the widest part.

No. 3. "*Young leaves of Nipa Palm.*"—This consisted of (*a*) a bundle of four leaves measuring from 5 ft. 3 in. to 5 ft. 9 in. in length and from 3½ in. to 4 in. across at the widest part, and (*b*) a bundle of six smaller leaves measuring from 4 ft. 7 in. to 4 ft. 11 in. in length and from 1⅞ in. to 2 in. across at the widest part.

Sample 1 and a mixture of samples 2 and 3 were examined in detail with the following results, which are compared with the corresponding figures for commercial esparto grass from Oran, Algeria:

	Sample 1.	Samples 2 and 3, mixed.	Algerian esparto grass.
	Per cent.	*Per cent.*	*Per cent.*
Moisture (in air-dry material)	16·1	14·1	8·8
Ash (on material dried at 100–110° C.)	8·2	3·6	3·0
Yield of unbleached pulp dried at 100–110° C.:			
(1) Expressed on air-dry material	27·7	20·0	29·5
(2) Expressed on material dried at 100–110° C.	33·0	23·8	32·3
Loss on bleaching	*	14·6	1·3
Yield of bleached pulp dried at 100–110° C. expressed on original material dried at 100–110° C.	*	20·3	32·0
Length of ultimate fibres	From 0·02 to 0·073 in.; average 0·048 in.	From 0·012 to 0·09 in.; average 0·036 in.	From 0·012 to 0·12 in.; average 0·045 in.

* *The quantity of pulp available was too small for the loss on bleaching to be determined in this case.*

The yield of pulp from the leaves (samples 2 and 3 mixed) was lower than that from Algerian esparto grass, whilst in the case of the "stems" or midribs (sample 1) the yield of unbleached pulp was about equal to that of esparto grass. The ultimate fibres from the "stems" (midribs) were equal in average length to those of Algerian esparto grass, whilst in the case of the leaves they were a little shorter. All the samples were readily convertible

into a brown pulp, and laboratory trials made at the Imperial Institute showed that a fairly good paper could be prepared from this pulp. The paper yielded by the leaves was not quite so strong as that obtained from the midribs.

The material represented by the present samples would not be of any commercial value in Europe except for paper making, and in order to ascertain its precise value for this purpose large-scale technical trials would have to be carried out. The material is too bulky and yields too little pulp to allow shipment to Europe in the crude state, but if the results of the technical trials were satisfactory it could either be exported from Sarawak in the form of "half stuff" or used locally for the manufacture of paper.

Scilla rigidifolia *Leaves from Swaziland, South Africa*

The leaves of *S. rigidifolia*, which are the subject of this report, were forwarded to the Imperial Institute by the Department of Agriculture at Pretoria in November 1911. It was stated that the plant grows in large quantities in Swaziland, and it was desired to ascertain its commercial value.

The sample weighed about 10 lb., and consisted of dry, rather brittle leaves.

The leaves contained a fair proportion of fibre, which, however, was very weak, and could not be profitably extracted for textile purposes. It is possible, however, that the leaves might find a market as a material for paper making, and they were examined at the Imperial Institute from this point of view.

The following table gives the results of the chemical examination of the leaves of *S. rigidifolia*, together with the corresponding figures for a sample of Algerian esparto grass:

	S. rigidifolia leaves. *Per cent.*	Algerian esparto grass. *Per cent.*
Moisture	9·5	8·8
Ash	3·8	3·0
Pulp (expressed on material as received)	32·0	29·5
Pulp (expressed on dried material)	35·4	32·3
Length of ultimate fibres of pulp	0·032 to 0·064 in.; average, about 0·04 in.	0·012 to 0·12 in.; average, about 0·045 in.

The dried pulp contained about 92 per cent. of cellulose. The ultimate fibres were narrow, pointed at the ends, and thick-walled, the lumen in some cases being almost obliterated.

These results show that the leaves of *S. rigidifolia* yielded a larger proportion of pulp than the sample of esparto grass with which they were compared, although the ultimate fibres of the pulp were somewhat shorter. It is therefore probable that the dry leaves would be saleable for paper making at a price approximating to that of Algerian esparto grass.

It is obvious that at this price the collection and exportation of the leaves of *S. rigidifolia* would not be profitable. It might, however, be possible to employ the leaves for paper making in South Africa, or to convert them into "half stuff" locally, and ship the latter to Europe, as in this way a considerable saving would be effected in the cost of transport.

WILD SILK FROM MEXICO

In previous numbers of this Bulletin reference has been made to wild silks from Africa produced by species of *Anaphe* (1907, **5**, 438; 1910, **8**, 150; 1911, **9**, 412; 1912, **10**, 163). In August of last year a specimen of wild silk from Mexico, differing in character from Anaphe silk, was received at the Imperial Institute from Prof. Robert Wallace, of Edinburgh. According to information supplied with the material, the silk is found hanging on certain trees in the States of Vera Cruz and Oaxaca, and is obtainable in large quantities. It is stated that in Oaxaca the Indians use it for making rope. The sample forwarded was in the condition in which it is found in the forests, but, having been gathered a month after the rains had started, was somewhat discoloured.

The sample consisted of a portion of a flat, loosely spun, web-like nest, measuring 12 by 18 in., thin at the edges, with a thick central portion composed of several layers of silky fibre. The fibres seemed to run chiefly in one direction from one end of the nest to the other, but the

central part contained, besides these long fibres, a few very thin cocoons. A large quantity of sloughed caterpillar skins, dead caterpillars, leaves, excrement, bark, etc., was present, and one very thin complete cocoon contained a caterpillar, which was about 1 in. in length, and was covered with rather long brown hairs.

The material, when handled, was found to have an irritating effect on the more tender portions of the skin, probably owing to the caterpillar hairs, which were present among the silk.

On microscopic examination the silk was found to consist chiefly of single strands, but a few double strands were present. These double strands varied in diameter from 0·0005 in. to 0·0013 in.

A portion of the nest was cut off and freed as far as possible from extraneous matter by shaking and picking. By this means it was separated into web, 24 per cent., and extraneous matter, 76 per cent. The web was submitted to chemical examination with the following results:

	Per cent.
Moisture	12·1
Loss on degumming (expressed on the web dried at 100–110° C.):	
(1) After boiling 1½ hours in a 1 per cent. soap solution, washing with water, and drying at 100–110° C.	38 (approx.).
(2) After boiling one hour in a 3 per cent. soap solution, washing in water, and drying at 100–110° C.	33 (approx.).
(3) After boiling half an hour in a 3 per cent. sodium carbonate solution, washing in water, then boiling half an hour in a 3 per cent. soap solution, washing again in water, and finally drying at 100–110° C.	49 (approx.).

The degummed silk, which varied in colour from grey to greyish-brown, was of good lustre and fair strength, but it was difficult to comb out, and still contained many particles of extraneous matter, which were not easy to remove. The diameter of the clean fibres varied from 0·0002 to 0·00065 in., the average being 0·00035 in.

It was found that the use of sodium carbonate solution in degumming greatly weakened the fibre.

The silk contained in such nests as these could not be reeled, but would have to be carded and spun, and it is probable that the large amount of small fragments of

extraneous matter would render it very difficult to clean sufficiently for the carding and spinning to be satisfactorily accomplished. Moreover, the nests would yield only about 10 to 15 per cent. of clean degummed silk, and the irritating effect of the material on the skin must also be taken into account. It is therefore improbable that nests of the kind represented by the present sample would find a market among silk spinners.

The silk nest and specimens of the caterpillars were submitted to the Imperial Bureau of Entomology for determination. The Bureau reported that the larvæ are very similar to those of *Thaumatopœa processionea*, the European "Processionary Moth," and may be closely allied thereto, but that specimens of the actual moth would be necessary in order to identify the species.

KHAYA NYASICA TIMBER FROM MOZAMBIQUE

THE *Khaya nyasica* timber which is the subject of this report was received at the Imperial Institute from the London Secretary of the Companhia de Moçambique in August 1913.

The sample consisted of a plank measuring 11 ft. by 2 ft. by 2 in., showing little sapwood on the edges, and well seasoned and uniformly sound throughout. The weight was 38 lb. per cubic foot.

The wood when freshly cut was pinkish-red with a brown tinge, but on exposure the colour improved to a deeper red-brown tint. It was uniform in texture, firm, moderately hard, and worked freely with both machine and hand tools. Cut and worked samples of the timber, when kept for about six weeks, showed no sign of warping.

Though coarser in the grain than the West African mahoganies, this timber took glue well, and could be used instead of mahogany for most commercial purposes, but it had not sufficient figure for use as a veneer wood. It polished well, and the tint, if in any way objectionable, could be modified in practice by an expert polisher.

The timber would be classed as a good average African mahogany, and if large logs could be shipped, as would seem possible judging by the present sample, this would be an important point in its favour.

A firm of timber brokers, who were consulted regarding the possible market for this wood, reported that it was of good quality, and so closely resembled mahogany that in their opinion there would be no difficulty in selling it as such. They added that many woods inferior to it are already being sold as mahogany.

The brokers stated that, if logs of good dimensions and in sound condition can be supplied, the wood should realise about 4*d.* to 4½*d.* per foot super, broker's sale measure, equivalent to say 2*s.* 9*d.* to 3*s.* 3*d.* per foot cube, actual measure; and they recommended that a trial shipment should be obtained for sale at auction in London.

CYMBOPOGON COLORATUS OIL FROM FIJI

THE essential oils derived from certain species of Cymbopogon are well known in commerce as "lemon-grass" and "citronella" oils (this BULLETIN, 1911, **9**, 240, 333). The former are derived mainly from *Cymbopogon flexuosus*, Stapf, and *C. citratus*, Stapf, and the latter mainly from *C. Nardus*, Rendle, var. "Lena-batu," in Ceylon, and from *C. Winterianus*, Jowitt, in Java. The chief constituent of the lemon-grass oils is citral, the proportion of which is usually between 70 and 80 per cent. The citronella oils, on the other hand, are characterised by the presence of considerable quantities of citronellal and geraniol, but contain very little or no citral.

In the course of a study of the various grass oils at the Imperial Institute, three interesting oils have been encountered which have not hitherto been described in detail, and which exhibit characters different from those of either the lemon-grass or citronella oils. One of these, derived from *C. polyneuros*, Stapf, grown in Ceylon, has a peculiar, sweet, penetrating odour, but has not been received in sufficient quantity for detailed investigation (this BULLETIN, 1912, **10**, 29); it is hoped, however, that a

further quantity will be forwarded in due course. The second, *C. senaarensis*, Chiov. (*loc. cit.* p. 31), contains an aromatic ketone as its principal constituent, and is now being submitted to examination. The third new oil is furnished by the leaves of *C. coloratus*, Stapf, and contains considerable quantities of citral and geraniol, but no citronellal.

In 1907 seeds of a supposed lemon-grass were forwarded to Fiji from India, and the plant, since identified at the Royal Botanic Gardens, Kew, as *C. coloratus*, Stapf, has been grown at the Nasinu Experiment Station. The fresh leaves of this grass, when distilled with steam, are stated to yield about 0·35 per cent. of oil (*Bulletin* No. 6, 1913, *Dept. Agric., Fiji*). Samples of oil distilled in Fiji were forwarded to the Imperial Institute in 1908 and 1909, and were subjected to a preliminary examination (this BULLETIN, 1912, **10**, 27), and in 1912 a small consignment of the oil was received for sale. The oil was also examined by Umney (*Perf. and Ess. Oil Record*, 1912, **3**, 317), who found it to contain 35 per cent. of citral and 30 per cent. of geraniol.

It was clear from this preliminary work that, as pointed out in the report already published in this BULLETIN (*loc. cit.*), this oil showed characters common to both lemon-grass and citronella oils; it contained, for example, citral, which is the most important constituent of lemon-grass oils, and also geraniol, which is an important component of citronella oil, especially of the variety exported from Ceylon. As the oil is therefore of considerable scientific and commercial interest, it has been submitted to a detailed chemical examination with a view to supplementing the data already published regarding it.

The results thus obtained have been communicated to the Chemical Society of London by Dr. E. Goulding, F.I.C., and Mr. J. C. Earl, A.I.C., of the staff of the Scientific and Technical Department of the Imperial Institute (*Proc. Chem. Soc.*, 1914, **30**, 10). These results may be summarised as follows:

The principal odoriferous constituents of the oil are *citral*, which is present to the extent of 40 per cent., and

geraniol, which occurs in the free state to the amount of 23 per cent., and in the form of *geranyl acetate* to the extent of 10 per cent. There are also present about 7·5 per cent. of *terpenes*, among which *l-limonene* is probably included, and small amounts of free *acetic acid* and phenols; from the latter, a solid, tasteless, and odourless *phenol* was isolated. For technical details of the methods used in identifying and estimating these constituents, the original paper should be consulted.

The small consignment of this oil referred to above was sold in London in January 1913 at 2*d.* per oz., with Cochin lemon-grass oil at 4¼*d.* per oz. and Ceylon citronella oil at 1*s.* 6½*d.* to 1*s.* 8*d.* per lb. The yield of this oil is, according to a statement in the Report on Agriculture, Fiji, for 1911, about 29 lb. per acre, which at the price quoted above for the oil is equivalent to a value of £3 17*s.* 6*d.* per acre.

FISH OILS AND GUANO FROM INDIA

THE preparation of sardine oil and guano forms an important part of the experimental work of the Madras Government Fishery Department. Hitherto such work has been carried on at the Cannanore Experimental Station, but during 1911–12 it was transferred to the Experimental Station at Tanur, where fish are usually more abundant. At first crude brown oil only was prepared, but as there is a better market for the finer grades of fish oil, new machinery has been installed at Tanur for producing pale-coloured oil, for separating the "stearin," and for refining the oil, whilst deodorising experiments are also to be conducted there. The efforts of the Department to create a local fish-oil industry have been highly successful; in 1909 there was only one private factory, whilst at the beginning of the 1911–12 season between forty and fifty small factories were producing crude brown oil in Malabar and South Canara, and it seems probable that factories will also be started in Cochin and Travancore.

As the supply of fish along the coast fluctuates considerably, and the amount of oil in the fish varies in different

seasons, it is suggested that a large number of small factories is preferable to a small number of central factories. Attempts have also been made to devise methods suitable for use by single native families, in order to establish a kind of cottage industry.

In the small factories where crude brown oil is being produced the methods followed are of a simple kind. The fish are boiled in open pans, holding one-half or two-thirds of a ton, and the resulting mass is placed in coarse coir bags and pressed in simple screw presses. The pressed cakes of guano are broken up and placed on mats in the sun to dry. The crude oil is stated to fetch Rs. 160 (approximately £10 10s.) per ton of about 250 gallons at the factory, the middleman supplying the casks and bearing the cost of transport; the guano realises about Rs. 70 (approximately £4 10s.) per ton.

Several samples of the sardine oil and guano made in Madras have been received recently at the Imperial Institute from the Madras Government Fishery Department, and as the results of their examination are of general interest, they are now published.

Sardine Oil and Stearin

Seven samples of sardine oil and one sample of stearin obtained from sardine oil were received in August 1912. They were as follows:

1. "Palest oil from Cannanore."—A pale yellow oil, which deposited stearin on standing.

2. "Palest oil without stearin."—This was a bright yellow oil, clear when received at the Imperial Institute, but, like the other samples designated "oils without stearin" (Nos. 4 and 6), it deposited stearin to some extent at the temperatures commonly prevailing in Europe, viz. up to 20° C.

3. "Palest oil with stearin."—A yellow oil with a deposit of stearin.

4. "Yellow oil without stearin."—A pale brown oil.

5. "Yellow oil with stearin."—A pale brown, viscous oil,

6. "Brown oil without stearin."—Thick brown oil, possessing an unpleasant odour.

7. "Brown oil with stearin."—Dark brown semi-solid oil, possessing an unpleasant odour.

8. "Stearin."—Pale brown, soft fat.

The samples were examined with the results shown in the following table; No. 7 contained about 3·2 per cent. of water, which was removed before the constants were determined:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Specific gravity at $\frac{100°\,C.}{15°\,C.}$	0·878	0·877	0·877	0·877	0·876	0·876	0·875	0·874
Acid value[1] . . .	3·7	2·3	1·8	4·7	7·1	35·0	53·5	9·0
Saponification value[1] .	196	194	194	193	198	199	200	198
Iodine value . *per cent.*	154	156	157	159	154	157	157	131

[1] *Milligrams of potassium hydroxide per gram of oil.*

The general characters and constants of these sardine oils indicate their suitability for the usual purposes to which fish oils are applied, viz. leather dressing and currying, and to a smaller extent for soft soap manufacture, tempering steel, admixture with paint oils, and jute batching. The stearin would also be suitable for use in leather manufacture and soap making.

The various fish oils used in commerce (*e.g.* cod, herring, menhaden, Japanese sardine and shark liver oils) differ a good deal from one another in physical and chemical characteristics, but they all have a high iodine value. This constant is of great importance, as it indicates the readiness with which an oil will undergo oxidation, a property on which the value of an oil for leather dressing largely depends.

The principal fish oil used in the leather industry of the United Kingdom is cod oil, commercial specimens of which usually have an iodine value of about 155. It will be noticed that the iodine values of these sardine oils from Madras (viz. 154 to 159) approximate very closely to this figure.

With the exception of the brown oils (Nos. 6 and 7), all

the samples had low acid values and appeared to have been carefully prepared. The somewhat high acid values of the brown oils would reduce their value for leather dressing, as such oils are usually regarded as unsatisfactory for this purpose.

Two further samples of fish oil were submitted for examination, in February 1913.

No. 9. "Brown oil with stearin."

No. 10. "Brown oil without stearin."

These oils were dark brown in colour and had a very unpleasant odour. They were filtered, and then chemically examined with the following results:

	Brown oil with stearin.	Brown oil without stearin.
Specific gravity at $\frac{100^\circ\ C.}{15{\cdot}5^\circ C.}$ . .	0·881	0·879
Acid value	12·1	11·8
Saponification value (approx.)	200·2	200·0
Iodine value . . *per cent.*	155·2	154·1

The constants of these two oils correspond on the whole with those of the previous samples.

The present specimens have much lower acid values than the two samples of brown oil (Nos. 6 and 7) then dealt with, but they were darker in colour and their odour was still more unpleasant.

The remarks made above as to the uses of the oils are also applicable to the present samples.

Fish Guano

The following samples of fish guano were received along with samples Nos. 9 and 10 above:

No. 1. "Fish guano prepared at the Government Fisheries Station, South Malabar."

No. 2. "Fish guano prepared at the Government Experimental Station at Tanur, South Malabar": (a) "Ordinary guano," (b) "Guano from large oily sardine."

The guanos consisted of fragments of the bones, flesh, and scales of small fish. They were examined with the following results:

	No. 1.	No. 2a.	No. 2b.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	7·86	8·82	8·68
Crude proteins	49·22	53·65	56·40
Consisting of:			
True proteins	43·75	45·41	49·06
Other nitrogenous substances	5·47	8·24	7·34
Fat	6·69	5·38	8·52
Other organic matter	7·37	4·73	5·01
Ash	28·86	27·42	21·39
The ash contained:			
Lime CaO	33·10	42·32	42·12
Potash K_2O	0·85	2·17	2·19
Phosphoric anhydride P_2O_5	29·52	35·32	35·56

The following table shows the percentages of lime, nitrogen, phosphoric anhydride, fat and water present in these three samples of fish guano from South Malabar, compared with the corresponding figures recorded for fish manure from other sources:

	Lime. CaO.	Nitrogen. N.	Phosphoric anhydride. P_2O_5	Fat.	Water.
No. 1	9·6	7·8	8·5	6·69	7·86
No. 2a	11·6	8·6	9·7	5·38	8·82
No. 2b	9·0	9·0	7·6	8·52	8·68
Fish manure from refuse (United Kingdom)	—	7·8	8·1	—	18·9
Dried menhaden scrap (U.S.A.)	—	8·0	8·5	—	Not exceeding 12·0
Norwegian cod heads and bones	—	8·0	14·9	—	13·0
Norwegian whale manure	16·5	7·6	13·4	—	5·3
Dried codfish skins and bones	—	8 to 9	10 to 12	—	5 to 6
Canadian dogfish scrap	—	8·8	7·7	16·6	5·5
Brittany fish manure	—	6·5	13·1	—	5·0

The commercial fish meal sold in Europe as food for cattle and pigs contains the following proportions of the most important constituents:

	Proteins.	Phosphoric anhydride.	Fat.
	Per cent.	*Per cent.*	*Per cent.*
English meal from fish refuse	50 to 65	6·6 to 8·5	3 to 6
Norwegian codling meal	50 to 60	11·3 to 13·1	1 to 2
Herring meal	60 to 70	3·7 to 4·7	10 to 12

A comparison of the figures given in the table above for well-known commercial fish manures with those recorded for the present samples of fish guano from South

Malabar shows that the latter contain about the same percentage of nitrogen as the other manures and an average amount of phosphoric anhydride, and there is therefore no doubt that they would be readily saleable as fish manures.

These Indian fish guanos are not quite so rich in proteins as the fish meals mentioned in the table on p. 54. They contain, however, average quantities of phosphoric anhydride and fat, and would no doubt be readily saleable for the preparation of feeding-stuffs of the fish-meal type, provided they are prepared from fresh fish and are kept in good condition.

THE COMPOSITION OF MONAZITE

In previous issues of this Bulletin (1905, **3**, 151, 285), detailed accounts have been given of the occurrence, distribution, and uses of thorium minerals. Of these minerals the most important from an industrial point of view is monazite, which is the source of most of the thoria used in the manufacture of incandescent gas mantles, and has acquired further importance recently as a source of the radio-active substance, mesothorium. (For an account of the utilisation of the rare earths other than thoria present in monazite, see this Bulletin, p. 110).

A large proportion of the monazite used industrially is obtained from deposits in Brazil, the quantity of sand containing 90 per cent. of monazite exported during 1912 being 3,398 metric tons. The most extensively worked deposits in Brazil are the naturally concentrated sands on certain parts of the sea coast, and the monazite separated from these contains on the average from 5·0 to 7·0 per cent. of thoria. The less important deposits inland yield monazite containing from 4·0 to 5·7 per cent. of thoria.

During the past two years an important contribution to the world's production of monazite sand has been made by the Native State of Travancore in India. The output in 1911 amounted to 811 tons, valued at £24,044, and in 1912 this had increased to 1,135 tons, valued at £41,419.

In the course of the Mineral Surveys conducted in connection with the Imperial Institute in recent years in Ceylon, Southern Nigeria, Northern Nigeria, and Nyasa-

land, many concentrates have been obtained which proved to contain monazite. This mineral had not previously been recorded from these countries, and particulars of the occurrences will be found in the official reports of these Surveys, which are published periodically in the Miscellaneous Series of Colonial Reports (London: Messrs. Wyman and Sons). Similar concentrates have also been received at the Imperial Institute from Travancore and Malaya.

The materials received at the Imperial Institute have been mostly in the form of sands already concentrated by washing. They contained numerous minerals other than monazite, and in such cases the monazites were separated from the concentrates by electro-magnetic or electrostatic means. In a few cases, the monazite examined consisted of a single fragment weighing several grams.

Complete analyses of monazites from all these sources have been made in the Scientific and Technical Department of the Imperial Institute, and the results have been communicated recently by Mr. S. J. Johnstone, B.Sc., of that Department, to the Society of Chemical Industry (*Journ. Soc. Chem. Indust.* 1914, **33**, 55). For information as to the methods of analysis used and other details the original paper should be referred to, as only a summary of the results obtained can be given here.

Monazite from Ceylon

	1. Monazite pebble from Naminkanda, Morawak Korle.	2. Monazite pebble from Muladiwanella Durayakanda, Gilimale.	3. Sand from Niriella-ganga.	4. Monazite pebble from Ratna-pura.	5. Monazite pebble from Ratna-pura.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Thoria ThO_2 .	9·75	9·49	10·75	10·29	28·20
Ceria Ce_2O_3 .	27·51	27·15	26·71	27·37	20·65
Lanthana and allied oxides La_2O_3, etc.	29·59	29·59	30·06	30·13	21·63
Yttria and allied oxides Y_2O_3, etc.	2·54	3·93	1·46	2·14	0·94
Ferric oxide Fe_2O_3 .	1·27	0·87	1·09	0·81	1·13
Alumina Al_2O_3 .	0·61	0·17	0·70	0·17	0·29
Lime CaO. .	—	0·45	0·85	0·41	0·10
Silica SiO_2. .	1·78	1·67	2·47	1·03	6·09
Phosphoric anhydride P_2O_5. .	26·12	26·12	24·61	27·67	20·20
Loss on ignition . .	0·59	0·48	0·93	0·20	—
Specific gravity . .	5·20	5·25	—	5·23	5·47

From these results and numerous partial analyses made at the Imperial Institute, it is evident that the Ceylon monazite usually contains about 10 per cent. of thoria, which is nearly double the amount found in the monazite of Brazil. It must be mentioned, however, that as little as 5 per cent. of thoria has been found in certain monazite sands from Ceylon, but material of this character appears to be of somewhat infrequent occurrence. Occasionally, specimens are met with having an unusually high specific gravity and a correspondingly high percentage of thoria, which it will be seen has reached over 28 per cent. (column 5 in table). The Ceylon monazite in general is very similar in composition to one of the Norwegian varieties, the analysis of which is given on p. 60.

Monazite from Travancore

Two specimens of this monazite gave the following results:

		No. 1. *Per cent.*	No. 2.[1] *Per cent.*
Thoria	ThO_2 .	10·22	8·65
Ceria	Ce_2O_3 .	31·90	61·11
Lanthana and allied oxides	La_2O_3, etc. .	28·00	
Yttria and allied oxides	Y_2O_3, etc. .	0·46	0·62
Ferric oxide	Fe_2O_3 . .	1·50	1·09
Alumina	Al_2O_3 . .	0·17	0·12
Lime	CaO . .	0·20	0·13
Silica	SiO_2 . .	0·90	1·00
Phosphoric anhydride	P_2O_5 . .	26·82	26·50
Loss on ignition		0·46	0·45

[1] *Isolated from a concentrate supplied by the State Geologist, Northern Division, Travancore.*

These analyses show that the monazite of Travancore contains a high percentage of thoria, approaching that of ordinary Ceylon monazite. According to E. White (*Thorium and its Compounds*, p. 10), up to 14 per cent. of thoria has been found in Travancore monazite.

Monazite from Malaya

Monazite sand has been found in many localities in the Federated Malay States and the protected States of Kedah

and Kelantan in association with alluvial tinstone (this BULLETIN, 1906, **4**, 301; 1911, **9**, 99).

The following are the results of analysis of samples of typical monazites from this source:

		Locality.	No. 1.[1] Puchong Babi, River Kenring, Perak.	No. 2.[1] Kulim, Kedah.	No. 3. Kelantan.
			Per cent.	*Per cent.*	*Per cent.*
Thoria	ThO_2	. .	3·40	3·53	9·41
Ceria	Ce_2O_3	. .	33·74	64·05	60·00
Lanthana and allied oxides	La_2O_3, etc.	.	32·53		
Yttria and allied oxides	Y_2O_3, etc.	.	0·91	2·40	2·82
Ferric oxide	Fe_2O_3	. .	0·65	0·64	1·13
Alumina	Al_2O_3	. .	0·03	0·07	
Lime	CaO	. .	0·33	0·17	0·29
Silica	SiO_2	. .	1·45	1·08	2·20
Phosphoric anhydride	P_2O_5	. .	26·58	27·87	23·71
Loss on ignition	. . . .	.	0·94	0·52	0·94

[1] *Isolated from concentrates supplied by the Geologist to the Federated Malay States Government.*

These figures show that there are wide variations in the percentage of thoria in monazite from Malaya, from the Perak specimen, containing only 3·4 per cent., to that from Kelantan, which contained over 9 per cent., and is superior in this respect to the average Brazilian material.

Monazite from Nyasaland

The following are the results of an analysis of monazite separated from a concentrate obtained from a stream at Namalundo Hill, near Chiromo in the Nyasaland Protectorate.

		Per cent.
Thoria	ThO_2 . .	7·10
Ceria	Ce_2O_3 . .	32·52
Lanthana and allied oxides	La_2O_3, etc. .	26·91
Yttria and allied oxides	Y_2O_3, etc. .	1·50
Ferric oxide	Fe_2O_3 . .	1·10
Alumina	Al_2O_3 . .	0·20
Lime	CaO . .	0·32
Silica	SiO_2 . .	1·66
Phosphoric anhydride	P_2O_5 . .	28·16
Loss on ignition	. . . . .	0·25

From the results of numerous partial analyses made at the Imperial Institute on other samples of monazite from Nyasaland, it would appear that the average thoria content is about 6 per cent.

Monazites from Nigeria

		Northern Nigeria.			Southern Nigeria.		
Number		1.	2.	3.	4.	5.	6.
Locality		Ekole.	Kadera, Central Province.	Jarawa river, Naraguta.	Iboboto stream, Nsan-Oban track.	Between Iboboto stream and Ebara river.	Ebara river.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Thoria	ThO_2	5·00	3·20	8·00	6·19	2·30	5·50
Ceria	Ce_2O_3	30·72	36·53	30·50	30·38	34·58	31·40
Lanthana and allied oxides	La_2O_3, etc.	30·02	30·00	28·80	29·60	29·83	29·20
Yttria and allied oxides	Y_2O_3, etc.	2·74	0·39	1·43	1·33	1·29	2·00
Ferric oxide	Fe_2O_3	3·00	1·20	0·81	1·50	1·80	0·75
Alumina	Al_2O_3	0·35	0·10	0·20	0·10	—	0·05
Lime	CaO	0·15	0·21	0·17	0·16	0·19	0·10
Silica	SiO_2	1·20	0·63	1·79	0·85	0·73	0·82
Phosphoric anhydride	P_2O_5	26·29	28·29	28·16	29·70	29·71	29·92
Loss on ignition		0·25	0·20	0·21	0·33	0·21	0·44

It would appear from analyses Nos. 4, 5, and 6 above, that monazite from different parts of the same locality, and apparently derived from the same source, may contain widely different percentages of thoria, but further work is necessary to confirm this point, which is of considerable commercial and scientific importance. The above results show that the percentage of thoria in monazite from Nigeria may vary between fairly wide limits. The average thoria content of a large number of Nigerian monazites examined is 5·5 per cent. for those from Northern Nigeria, and 5·8 per cent. for those from Southern Nigeria. The results show that these monazites, as a whole, are nearly as rich in thoria as those exported from Brazil.

For comparison with the foregoing results the following analyses of monazites from other sources may be given.

		1. Brazil.		2. United States.		3. Canada.	4. Australia.	5. S. Norway.
		Espirito Santo.	Alcobaca, Bahia.	Amelia County, Virginia.	Burke County, North Carolina.	Ottawa, County Quebec.	Emmaville, New South Wales.	—
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Thoria	ThO_2 .	6·06	6·50	14·23	6·49	12·60	1·23	9·34
Ceria	Ce_2O_3 .	62·12	61·40	29·89	31·38	24·84	36·64	28·06
Lanthana and allied oxides	La_2O_3, etc. .			26·66	30·88	26·41	30·21	29·60
Yttria and allied oxides	Y_2O_3, etc. .	0·80	0·70	—	—	4·76	—	1·82
Ferric oxide	Fe_2O_3 .	0·97	1·50	—	—	1·07	—	0·66
Alumina	Al_2O_3 .	0·10	0·08	—	—	—	3·11	0·16
Lime	CaO .	0·21	0·30	—	—	1·54	—	0·53
Silica	SiO_2 .	0·75	0·64	2·85	1·40	0·91	3·21	1·65
Phosphoric anhydride	P_2O_5 .	28·50	28·46	26·12	29·28	26·86	25·09	28·27
Loss on ignition	.	0·38	0·64	0·67	0·20	0·78	—	0·21

SPECIAL ARTICLE

AGRICULTURE IN THE BELGIAN CONGO

By E. Leplae

Director-General of Agriculture, Colonial Office, Brussels

The total area of the Belgian Congo amounts to about 909,654 square miles, with a native population estimated at 10,000,000. The terrible disease, "sleeping sickness," has made great ravages in many districts, but the situation is improving, thanks to the measures taken by the State during the last few years.

Native Agriculture

With few exceptions, the native tribes follow agriculture, the clearing of the land being done by the men, while the planting and care of the crops is left to the women. The central part of the Congo is covered by vast equatorial forest, where the rainfall is fairly evenly distributed over the twelve months of the year. The principal food crops in this zone are manioc (cassava) and bananas, to which may be added maize, sugar-cane, sweet-potatoes, and various crops of minor importance. The oil-palm affords an important part of the food supply

in a large part of this district. It is difficult to raise cattle with success in the forest region, and the natives do not attempt it; they have, however, goats, sheep, fowls, pigeons, and Barbary ducks.

The equatorial forest is surrounded by a wide belt of savannahs, which run along the frontiers of the State, covering the Lower and the Middle Congo, Kasai, Katanga, the region of the Great Lakes, and the east of Uele. The cereal crops in this region are numerous and important. The natives plant sorghum, maize, millet, eleusine, peanuts (ground nuts), haricots, and sesamum; manioc and plantains are also generally cultivated, except in the highest parts, where these plants ripen too slowly. In certain districts cattle are kept, and small cattle and poultry are reared in all parts.

The natives cultivate numerous varieties of each of the plants included in their usual crops. The study of these varieties has now been commenced by the Agricultural Department, and promises to be highly interesting. In the Bokala region alone, an agent collected fifteen sorts of manioc from the native crops, whilst another discovered twenty-two kinds of plantain trees in Mayumbe.

The origin of the plants in the native plantations often goes back to importations made by foreign traders. The Portuguese, coming from Angola, introduced certain varieties of cotton; the Arabs imported from Zanzibar fifty years ago, wheat, rice, cotton, and several fruit trees. Numerous species and new varieties are being introduced now at the State agricultural stations, and in those maintained by the missions; they come from foreign colonies, and especially from the British and Dutch East Indies, and will be distributed among the agricultural population. The State also distributes to the natives of certain districts cattle, goats, and sheep.

The growth of important towns such as Boma, Leopoldville, and Stanleyville, and the assemblage of large bodies of labourers for railway construction and the working of the mines, have opened remunerative markets to the natives for the sale of food-stuffs, with the result that a notable extension of certain crops has taken place,

especially that of rice. In many parts the same is true for European vegetables, and certain tribes (*e.g.* the Marungu) have even adopted the regular cultivation of potatoes and wheat.

Native agriculture is, incontestably, progressing in the whole territory, and the State is doing its best to find new means of developing it. Great progress will be made if it is possible to persuade the natives to add, to their actual food crops, small plantations of commercial and industrial products, such as rubber-, fibre- and oil-yielding plants, coffee, cocoa, kola, etc. This question has been very much to the fore since the fall in the price of rubber seriously affected the commercial companies established in the Belgian Congo, and various proposals have been made to develop the agricultural production of the natives in a commercial way. The companies can themselves contribute powerfully towards this end by obliging their agents to buy the produce cultivated by the natives, instead of, as they have done up to now, only buying rubber, copal, and ivory. Important markets could thus be created for peanuts, palm-oil, cotton, coffee, cocoa, etc., provided that the transport rates towards the coast and the factories are sufficiently reduced. This reduction is actually being considered. The State can intervene very efficaciously, not only by reducing the transport rates, making roads, devising suitable measures for creating markets, and distributing seeds and plants; but also by buying from the natives the different products for which it would be difficult to find a sale at first. Instead of trying persuasion alone, the State might oblige the natives to cultivate certain crops that they could sell for their own exclusive profit. It could, for instance, replace the payment of taxes, during a certain number of years, by the obligation to plant a certain number of trees or a certain area. Such compulsory planting is attracting much attention at the present time, because it would have the undoubted advantage of rapidly creating a native landed interest and capital.

Similar measures have been adopted in some foreign colonies. In the Samoan Islands the German Government has since 1900 imposed, on each male adult, the obligation

to plant and maintain fifty coconut trees. In this way the native production of copra has been quadrupled, and the natives themselves have thoroughly understood that it is to their own interest to submit to the Government measures. The area planted is increasing, and surpasses the minimum required by the law, whilst the number of infractions of this regulation is decreasing from year to year. Analogous regulations have been suggested for the Belgian Congo. To each adult native would be allotted sufficient land to produce his food-crops (manioc, rice, maize, peanuts, etc.), and also a certain number of trees or plants, yielding a commercial product, which would be, according to the locality, rubber, coffee, cocoa, oil-palm, coconuts, cotton, etc. The native would be exempted from payment of taxes during the number of years necessary for the establishment of these plantations, which would be compulsory and would be rigidly controlled by special agents, whose duties would be to determine the conditions of planting, to verify the state of the crops, etc. When the plantations commenced to yield, the native would have to pay taxes as before, and the land under cultivation would become his property, the entire crop belonging to him. Special laws would forbid the sale of these plantations to Europeans, or their appropriation by a third party.

The result of this system would be, after a few years, to give to a large number of natives an appreciable revenue and to rapidly increase the production of the Colony, and, at the same time, to enrich the public treasury by the duties levied on exports.

By applying this measure to the production of Para rubber, for instance, each native would have to plant one hundred trees in five years. After ten years, at the rate of 600 grams of dry rubber per tree, the yield of the plantation would be 60 kilograms per annum, worth 2*s.* per kilogram, equal to a sum of £6. If 500,000 natives, one tenth of the tax-payers, were compelled to make these plantations, the annual crop would be worth £3,000,000.

Real advantages would therefore follow on compulsory planting—it would supply a fairly simple means of overcoming the apathy and heedlessness of the blacks, it would

assure the livelihood and permanence of the population, and it would promote trade and provide the State with taxable commodities.

Put in force in the populous regions, inhabited by active agricultural tribes, compulsory planting would very rapidly create an intense commercial development. This would be especially the case in the Kasai district, where the villages often count from 1,000 to 5,000 inhabitants, all agriculturists.

There appears to be little doubt that the natives would understand readily the advantages resulting to each of them from the possession of a well-established plantation, kept up almost without any expense.

A careful selection ought to be made, of course, between the numerous trees and plants that could be raised by natives. Crops that grow and yield with very little trouble and labour would be the most suitable. For instance, Funtumia, close planted and tapped three times only in a year, would probably do better than Hevea, unless the latter could be tapped in a very simple manner, similar to Brazilian tapping.

State Breeding Stations

Experiments relative to cattle-breeding are being made at the following stations:

Zambi (Lower Congo).—Founded in 1895, this station, situated 24 miles from Boma, on an arm of the river, is principally used as a quarantine station and for the purpose of acclimatising animals imported from Europe and foreign colonies. Seventy-two horses, 73 donkeys, 4 mules, 129 native cattle, 33 Belgian cattle, 12 cattle from Dahomey, 20 zebus from South India, 1 buffalo, and 38 pigs are being maintained here. One hundred and twenty-five acres of pasture have been created from which the tsetse fly has disappeared. A laboratory for veterinary experiments has been added to this station, which also possesses a laboratory for soil analysis. The staff includes two veterinary surgeons, a chemist, and three agricultural agents.

Kitobola (Lower Congo).—This station, founded in 1898, possesses an irrigating plant and its fertile lands are

in regular culture, producing cereals, and fodder for the farm animals. The herd comprises 120 cattle, 2 horses, and 4 pigs. The work of clearing the jungle, commenced in 1913, has for its object the elimination of the tsetse fly from the pastures. The staff comprises three European agents and 200 natives.

DOLO.—This station, situated 5 miles from Leopoldville, has 216 cattle, 20 donkeys, and 52 sheep and goats. A veterinary surgeon is quartered here. The farm is under the direction of two agents, who supervise the work of 100 natives.

TSHOPO (Stanleyville).—This farm has 78 head of cattle and 33 sheep.

NYANGWE (Maniema).—This station was founded in 1900. The herd is composed of 533 cattle, 2 horses, 52 donkeys, and 20 sheep.

MIAO (Kasai).—Founded in 1912, this farm keeps the State herds which were formerly at Lusambo and Luluabourg. There are 459 head of cattle, 6 horses, 12 donkeys, 1 mule, 110 sheep, and 28 goats. A veterinary surgeon and an agricultural agent are attached to this station, with 100 native workmen.

KATENIANIA (Katanga).—This post, founded in 1912, is established on the high tableland of the Biano Hills; as annexes it has the posts of Mufumai and Kimbundji. The herd is composed of 491 cattle of Barotse breed, 55 sheep and goats, and 11 pigs. The staff includes a veterinary surgeon and three agents.

DITUNGURU and MUTAMBALA (Katanga).—Established in 1911 on the tableland of the Kundelungus, near Lake Moero, the station at Ditunguru has received the herd from the old post at Lukonzolwa and maintains 108 head of cattle and 90 sheep and goats. The neighbouring post at Mutambala in Marungu, near Lake Tanganyika, has a small herd consisting of 74 head of cattle.

API and ANGO (Uele).—These stations are for taming elephants. The Api station was founded in 1900. With a branch at Ango, it maintains 33 African elephants of different ages. The staff is composed of two European agents and 60 blacks.

The results of the principal investigations accomplished at these State Breeding Stations on the different species of domestic animals may be summed up as follows:

1. *Tsetse Fly.*—In the whole of the forest region and in the greater part of the savannahs, the danger of infection from tsetse fly is permanent. Great care must be exercised in choosing situations for cattle-breeding stations and the jungle must be thoroughly cleared in the neighbourhood of the pastures, and especially along the banks of rivers and streams. This clearing of the jungle is very efficacious, and almost completely removes the tsetse fly.

2. *Feeding.*—The better the feeding the less susceptible are the animals to sickness, and especially to the attack of the tsetse fly. The establishment of a breeding station ought to be accompanied by the creation of pastures and the cultivation of fodder, assuring the proper alimentation of the animals at every period of the year. The natural pastures of the savannahs can be rapidly improved by removing the bushes, repeatedly mowing the grass, and by sowing fodder-producing seeds. In certain years the abnormal dryness is very harmful to the animals; it is therefore necessary to have recourse to irrigation for the fodder, or the pastures should be situated on land which retains sufficient moisture even at the end of the dry season.

3. *Horses.*—Horses are useful, especially for riding and driving purposes, and may also be used for the production of mules. Several breeds of horses have been imported into the Belgian Congo. The small breeds or ponies become acclimatised most rapidly, more especially the "Cayor" and "Bayar" (Senegal) breeds, which, without difficulty, support the great heat of the Lower Congo. The State has just bought from Java and sent to the Zambi station a few ponies of the Sandelwood breed. Coming from a hot and damp climate, these horses will probably adapt themselves to the climatic conditions of Central Congo.

4. *Donkeys and Mules.*—The small grey Senegal donkeys have shown the greatest resistance to the climate of the Lower Congo, and breed there without difficulty. The tall donkeys from Italy and France do not stand the heat so well, but apparently their breeding ought to be

successful. The mule-breeding experiments are still incomplete.

5. *Angola Cattle.*—These animals are raised at the State stations and at the missions in the Lower Congo. They breed normally, except during the exceptionally dry years, but they give hardly any milk, and fatten slowly. They can be rapidly improved by crossing with European cattle. The crosses obtained at Zambi, Kitobola, and Dolo, show a good milk production and furnish meat that is already quite satisfactory, but the infusion of European blood must not be pushed too far, or the capacity of the cattle to stand the heat will be diminished, and large cattle, for which it will be difficult to produce enough fodder, will be produced.

6. *Barotse Cattle.*—The high and grassy tablelands of Katanga are free from tsetse fly and suitable for breeding cattle. A herd of a few hundred Barotse cows has been introduced from Northern Rhodesia. They will be crossed with English bulls bought at Livingstone.

7. *Uele Cattle.*—In this province fairly large cattle of the Dinka and Waday breeds from the Nile are most numerous. They have been introduced at different periods as far as the centre of the colony. The former are fairly good milk producers. The small Lugwaret breed, from 3 ft. 8 in. to 4 ft. high, is the real native breed of North-Eastern Congo.

8. *Kivu Cattle.*—The natives of the mountainous regions of Kivu raise many cattle, partly belonging to the German West African breeds. Some are without horns, others with short or long horns. The small hornless breed is distinguished for its qualities as a milk yielder and the ease with which it is fattened, but it is rather scarce. The short-horned race is a little larger; it is also a good milk producer. The long-horned breed, 4 ft. 8 in. in height, gives little milk, and is difficult to fatten. The breeding stations founded by the State in the Kivu region have not been maintained, as the natives are careful cattle breeders. Every family has a few head of cattle, and the cattle sleep in the native huts. The action of the Government will be limited to the introduction of cattle for the improvement of the local breeds.

9. *European Cattle.*—A certain number of Belgian bulls have been sent to Zambi to be crossed with the native Angola cattle. These animals, fed in the stable and grazing every day, generally stand the climate of the Lower Congo for several years. The results obtained to date show a very perceptible improvement as regards both the meat- and the milk-producing qualities. Belgian cows were also sent with the object of producing animals of pure Belgian breed in Africa itself for the improvement of the local cattle.

Some milch cows of the small black and white Brittany breed were imported from France in 1912, and the raising of these on the Zambi pastures has continued till now in a satisfactory manner. These small and frugal cows give very satisfactory results as milk producers.

10. *Dahomey Cattle.*—The French colony of Dahomey produces a breed of very small cattle, of no milking value, but suitable for meat production. Trials with this breed are in progress at Zambi.

11. *Indian Zebus.*—Ten cows and two bulls belonging to the white Nellore breed were bought in India and located at Zambi, where they are now well acclimatised. Calves are numerous and are in good condition. The zebu will be able to render great services as a draught and pack animal.

12. *Italian Buffaloes.*—The domestication of Congo buffaloes has not yet been undertaken, although these animals are very numerous, and in some parts herds of from two to three hundred head are to be found. Italian buffaloes were imported in 1911, but the greater number died soon after their arrival, probably owing to an attack of "barbone" (*septicæmia hæmorrhagica*). One cow remains, and for the last two years has been in excellent condition.

13. *European Goats, Sheep, and Pigs.*—Some European milch goats have been introduced into the Lower Congo and sent to the interior for the purpose of improving the local breeds, which generally give very little milk.

14. *Pigs.*—The breeding of European pigs has been undertaken at Zambi, and has given encouraging results.

15. *Poultry.*—The native fowl is very small but very hardy. Several European breeds are being used for the improvement of the local poultry, with the object of obtaining cross-bred fowls of medium size. Certain of the stations are provided with incubators.

16. *African Elephants.*—The domestication of the African elephant has been under trial since 1901 at the Api post (Uele), under the direction of Commandant Laplume. The herd actually numbers thirty-three tame elephants, of which the greater number are quite docile and can be harnessed to ploughs and vehicles. The oldest of them are in regular work.

17. *Zebras.*—A herd of ninety zebras was captured in Katanga in 1914 and underwent taming and training. It was possible to break in several zebras for riding purposes, but the mortality was very high, and several accidents caused the enterprise to be abandoned.

The Veterinary Service.—There are at the present time fourteen veterinary surgeons in the Belgian Congo, of whom four are in Katanga. The duties of these officers are to see to the observance of the regulations relating to the health of domestic animals, to inspect slaughter-houses and meat markets, to study and improve native methods of cattle breeding, to treat animals that are ill in the State breeding stations as well as those belonging to private persons, and, finally, to assist in the scientific researches made at the veterinary laboratory at Zambi by collecting material for study.

The Distribution of Cattle to the Missions and to Private Persons.—The greater number of the missions undertake the breeding of large or small cattle. Some of the mission herds are very important; thus the Jesuits' missions at Kisantu and its neighbourhood maintain upwards of 800 head of cattle.

The State does its best to encourage these enterprises by placing at the disposal of the missions and of private owners animals of good breeds. According to the present regulations, the males are given gratuitously, while the females are lent under the condition that the original number must be returned at the end of five years.

Experimental Farms

The following agricultural stations are devoted to experimental cultivation:

Botanical Garden at Eala (Equator).—Founded in 1900, the Eala botanical garden is situated on the Equator, in a hot and damp climate, which represents the average climate of the forest region. The average annual rainfall is 80 in., fairly regularly distributed over the twelve months of the year, with two rather drier periods, one about January, the other about July.

The temperature is remarkably constant; the average minimum temperature is 68° F. and the average maximum 86° F. The average temperature for the whole year is 77° F.

The Eala botanical garden is provided with varied and interesting plantations. The botanical collection comprises upwards of 1,200 species and varieties, of which 600 belong to the flora of the Congo. The economic collections occupy about 200 plots of land, and include the most important varieties of cultivated tropical plants, including rubber, gutta-percha, and balata; copal; coffee, cocoa, tea; plants yielding essential oils; tinctorial plants; tanning, medicinal, and aromatic plants; textile and oil-seed-yielding plants; fruit trees; alimentary and fodder plants.

Quantities of seeds and of plants of economic or ornamental value are sent from the Eala botanical gardens to the agricultural stations and posts in the Colony, also to the missions and to private individuals. Exchanges with foreign botanical gardens are regularly made.

The Eala garden has now been placed under the control of Dr. Vermoesen, Director of the mycological service and of the laboratory for plant diseases. The laboratory for applied entomology has lately been transferred to Eala.

The staff of the station comprises four European agents, controlling 300 natives.

Bakusu Station (Coquilhatville, Equator).—About 150 acres (12,000 trees) are planted with *Hevea brasiliensis*, and 80 acres (20,000 trees) with *Funtumia elastica*. These plantations are employed especially for tapping experiments.

and for the production of seed for the other stations of the Colony.

CONGO DA LEMBA (Lower Congo).—This station, situated 6 miles from the 40-kilometre post, on the Matadi railway, is one of the oldest in the Congo, and was at first reserved for the cultivation of coffee. It possesses specimens of many economic trees, 10 to 12 years of age. It is now used mainly for forming collections for the study of coffee, cocoa, fruit trees, and various industrial and commercial plants, to be distributed amongst the colonists and to the State agricultural stations. This station is especially rich in species and varieties of fruit trees from foreign colonies. A small flock of sheep is also kept here.

BARUMBU STATION (Aruwimi District).—This is principally reserved for the cultivation of cocoa (280 acres with 69,889 trees) and *F. elastica* (345 acres with 96,827 trees). The Barumbu station also includes a few old plantations of rubber vines and coffee, and a small number of Hevea trees. It is under the direction of a European agent with 200 native workmen.

Cocoa plantations succeed very well here, the soil being excellent; two-thirds of the trees are productive, and yielded in 1912 a crop of 30 tons of dry cocoa. There are some interesting plantations of cocoa interplanted with oil-palms.

KITOBOLA STATION (Lower Congo).—Situated on the river Lukuga, 9 miles from the station of Tumba, the Kitobola farm comprises 318 acres of excellent land, the greater part being irrigated, of which 285 acres are devoted to alimentary and experimental crops, and 33 acres to rubber and lime trees. The land was allocated as follows in 1913:

	Acres.		*Acres.*
Dry rice	45	Sweet-potatoes	40
Irrigated rice	43	Sugar-cane	11
Ceylon rice	4½	Manioc	2½
Java rice	7½	Cotton	5½
Maize	30	Flax	2
Fodder	14		

Comparison of American, Egyptian, and Indian cottons was started at Kitobola in 1913 under the supervision of an expert recommended by the British Cotton Growing Association; 50 acres are devoted to this experiment.

Coconut trees (2½ acres), oil-palm (5 acres), pea-nuts, castor-oil, sesamum, and jute plantations have been established this year.

The farm has extensive pastures, and, as already mentioned, maintains a large herd of cattle. The staff comprises four Europeans and 200 natives.

Owing to the fertility of the soil, the facilities for irrigation, and the possibilities of cattle breeding, the Kitobola experimental station is of great practical interest.

GANDA-SUNDI STATION (Mayumbe, Lower Congo).—Originally destined entirely for rubber plantations, this station has, since 1912, given considerable attention to the planting of cocoa. At the end of 1913, 1,050 acres were planted with *Funtumia elastica*, 50 acres with Hevea, and 350 acres with cocoa.

MUNAMA EXPERIMENTAL STATION (Katanga).—Founded in 1912, this station is situated 9 miles from Elisabethville. It was equipped in 1913 for the study of the varieties and the conditions of cultivation, of agricultural plants suited to the climate of the high lands of Katanga. It also undertakes the raising of poultry of different races in incubators, and maintains experimental hives of European and native bees. The following special work is in progress:

1. Investigation of the species and varieties of agricultural crops best adapted to local conditions. At present 28 varieties of maize, 11 of wheat, 5 of oats, 4 of barley, 3 of rice, 6 of sorghum, 8 of millet, 10 of tobacco, 12 of potatoes, 12 of beans, etc., altogether 181 varieties of 60 different plants, and 69 varieties of 19 kinds of fruit trees, are being tried and studied comparatively.

2. The study of crop rotations, chemical manures, fallows, and green manures.

3. The relations of the plant to the soil.

4. Comparison of different times of sowing and planting.

5. Determination of the best spacings for the principal agricultural plants.

6. Selection of various plants.

7. Formulæ for the sowing of permanent pastures.

8. Field trials.

The experimental station covers 70 acres of ground,

situated along the river Munama. The staff comprises a director, with two European agents, and 100 native workmen.

INTRODUCTION OF NEW ECONOMIC PLANTS.—The introduction into the Belgian Congo of new or improved varieties of economic plants is made either by means of exchanges with the Botanical Gardens or Agricultural Departments of foreign colonies, or by purchase, when large quantities of seed or of plants are required.

The Colonial Garden at Lacken, near Brussels

This garden was established with the object of cultivating and preparing interesting plants with a view to their introduction into the Colonies; it also makes exchanges with similar foreign establishments. There are now under cultivation in the greenhouses of this establishment 75 economic species and 200 botanical or ornamental species from the Congo, together with 550 other colonial species.

In order to accelerate the introduction of useful plants, an agent was sent, in 1913, to the British and Dutch East Indies to purchase large quantities of seeds and plants which were distributed among the experimental stations in the Colony, principally at Eala and Congo da Lemba. Tropical fruit trees of different varieties formed the principal part of these consignments, with palm trees, bamboos, rice, native food plants, etc.

PLANTATIONS

The number of plantations in the Belgian Congo supervised by Europeans is not yet very important, the greater number of the companies having only up to now bought from the natives rubber, copal, and ivory. Since the fall in the price of rubber, more attention has been paid to tropical plantations, and especially to the production of pea-nuts, coffee, cocoa, coconuts, palm oil and kernels, and cotton, as well as to the planting of different rubber trees.

Most of the plantations are established in Mayumbe and are devoted to the cultivation of cocoa. The area under cocoa is estimated at 9,500 acres, of which about 2,500 acres are in full bearing.

The plantations of rubber vines made by the State and the commercial companies have not yielded good results. The same may be said in general for the plantations of *Funtumia elastica*, the yield of which appears to be less than was hoped. Since 1910 a large quantity of Hevea has been planted, and more than 2,500 acres are devoted to this tree in the State plantations. The growth of these Hevea trees, when they are established in well-chosen ground, seems satisfactory and comparable with the growth in Malaya.

Colonisation

Efforts have been made during the last few years to introduce into certain parts of the Colony European agricultural colonists. The high-lying regions of the east and south appear suitable for a European population; the heat is moderate and the climate seems to be healthy.

The first attempt of this kind was made in Katanga in the region of the copper-mines. An Agricultural Department was organised there in 1911 and 1912, and several experimental farms for cultivation and cattle-breeding were established. In the region where tsetse is prevalent, steam power has been used for clearing purposes, with a view to the creation of small farms and vegetable gardens in the neighbourhood of Elisabethville. The first Belgian colonists were established in farms completely equipped at the expense of the State. Italian farmers have been sent to Lower Congo. The results of this work are promising.

Cattle breeding can only be carried on in these regions on the high tablelands where the tsetse fly does not exist. Cattle introduced from Rhodesia soon become acclimatised and keep in good condition. It will be possible to develop this industry as soon as the Bukama railway reaches the tablelands.

Laboratories for Scientific Agricultural Research

The beginnings of the State agricultural service in the Belgian Congo were analogous to most of those in other colonies, work being limited to practical experiments in plant cultivation and to cattle breeding on the Government farms.

It is now recognised that these methods are not sufficient, and that the study of tropical agricultural problems requires scientific investigations, conducted by a staff trained in this kind of research and having at its disposal fully equipped laboratories.

The Agricultural Department has recently organised the following services of this kind :

LABORATORIES FOR THE STUDY OF SOILS AT ZAMBI AND ELISABETHVILLE.—These two laboratories were created in 1913. They are under the management of two chemists, and a specialist has been sent to Germany, Austria-Hungary, and Russia in order to study the latest methods of soil research.

LABORATORY FOR THE STUDY OF PLANT DISEASES.—A phytopathologist who has studied in the laboratories of mycology in the British and Dutch East Indies, during the year 1912, has been entrusted with the organisation of the service of phytopathology in the Belgian Congo. The laboratory will be erected at the Eala botanical garden. The first researches for this service were made in Mayumbe, on diseases of cocoa.

LABORATORY OF APPLIED ENTOMOLOGY.—The entomologist of the Agricultural Department commenced his researches in 1912 and 1913 at the Congo da Lemba station and in the Mayumbe cocoa plantations. The laboratory of entomology will be situated at Eala, to work in conjunction with the laboratory of mycology.

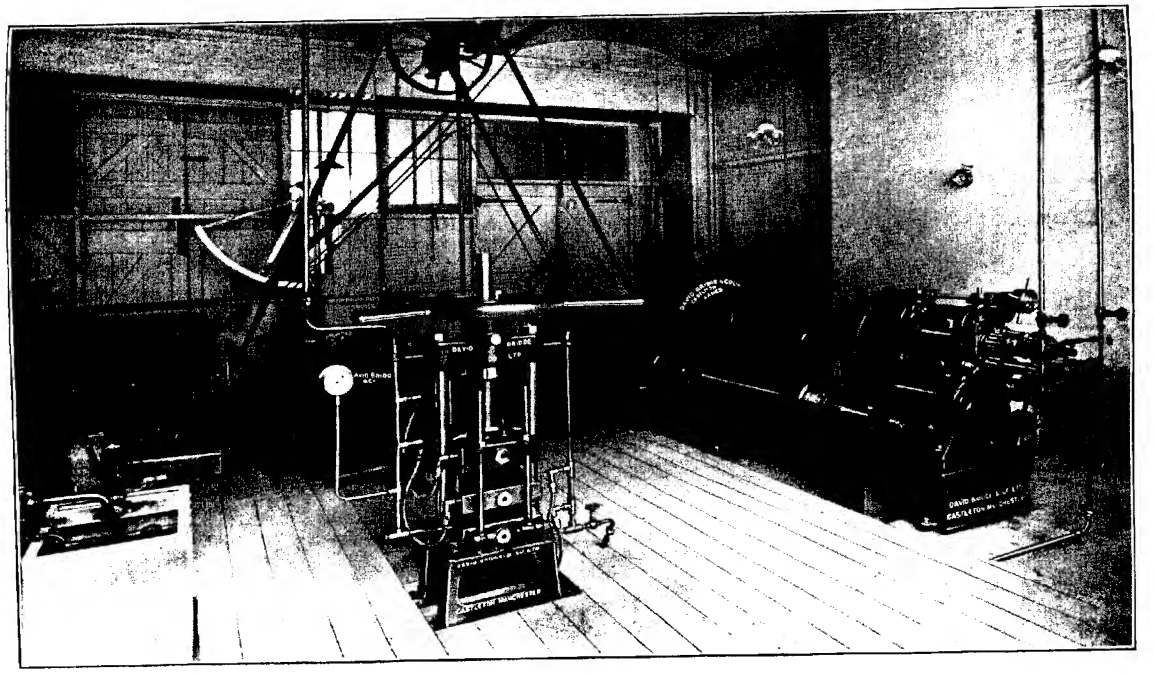
VETERINARY RESEARCH LABORATORY.—This establishment is situated at Zambi (Lower Congo), where special facilities are offered for studies in connection with the diseases of the different kinds of domestic animals, especially trypanosomiasis, and the tsetse fly. Two veterinary surgeons are stationed here; one of them has worked for some time in the laboratories at Nairobi and Pretoria.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT

RUBBER-TESTING MACHINERY AT THE IMPERIAL INSTITUTE

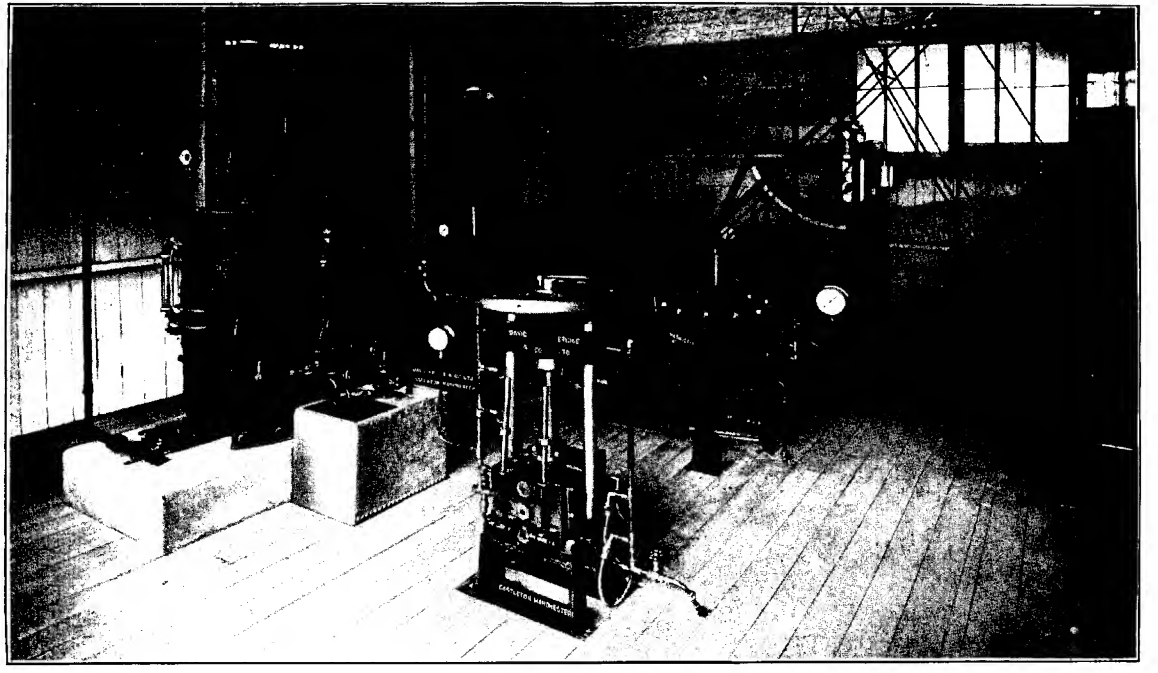
THE methods adopted for the preparation of plantation Para rubber have given rise to considerable discussion among agricultural officers and planters in the East, and a number of proposals have been made with the view of raising the average quality of the rubber in comparison with fine hard Para, and of securing greater uniformity in different consignments. In this connection, however, it has been felt that the present methods of judging the quality of rubber in the sale room are exceedingly crude and unsatisfactory, and that the only way to secure accurate data for comparison would be to carry out a careful scientific investigation of series of samples of plantation Para rubber prepared in different ways.

There can be no doubt that the best and most trustworthy method of judging the quality of a sample of rubber is to vulcanise a portion and to submit the vulcanised product to mechanical tests, as by this means the behaviour of the rubber under manufacturing conditions can be studied and its technical quality and value determined. Some work on these lines has already been carried out, but much further investigation is required before the question of the best method of preparation for use on plantations can be solved. Recognising this fact, the Rubber Research Committee of Ceylon, in co-operation with the Department of Agriculture in the Colony, has arranged with the Imperial Institute to conduct a complete investigation of the whole question of the effect of different methods of preparation on the quality of the rubber, and this work is now in progress. A scheme of operations has been drawn up which includes the preparation in Ceylon of samples of rubber in different ways and under different conditions, care being taken that the individual factors are studied singly, and that specimens of rubber for comparison are prepared from the same sample of



Imperial Institute Rubber Research Laboratory. West Side.

PLATE II.



bulked latex. The rubbers thus obtained are to be submitted to vulcanisation and mechanical tests, and for this purpose there has been installed at the Imperial Institute a complete experimental vulcanising and testing plant, a short description of which will be of general interest.

The plant required for the vulcanisation experiments, consisting of a washing machine, a mixing machine, a three-bowl calender, a vulcanising press, a vulcanising pan, a vacuum drier, and a gas-fired boiler, has been supplied and erected by Messrs. David Bridge and Co., of Castleton, Manchester, the well-known rubber machinists, and embodies all the improvements which have suggested themselves to the firm as the result of their experience of the working of previous installations of the same kind. One of the large rooms in the basement of the Imperial Institute has been specially allocated for the reception of the machines and forms a completely equipped research laboratory for the mechanical testing of rubber (see Plates I and II). The chemical investigation of rubbers will be conducted, as heretofore, in the main laboratories of the Scientific and Technical Department.

The washing machine is fitted with diamond-cut chilled cast iron rollers, $4\frac{1}{2}$ in. in diameter and 9 in. long, the front roller being adjustable by means of a worm and worm wheel adjustment gear; it is supplied with hot and cold water for washing purposes.

The mixing machine has accurately turned, ground, and polished rollers, of the same size as those of the washer and adjustable by the same means. The rollers are hollowed and are fitted with water and steam connections so that they can be used either hot or cold (Plate III, Fig. 1).

The calender is fitted with three rollers similar to those of the mixer and adjustable by means of worm and worm wheel adjustment gear; it is provided with special cut gear and clutches so that the three rollers can be run at equal speeds or a friction speed obtained between the adjacent rollers, the changes being obtained by a simple movement of the clutches. The rollers can be either steam-heated or water-cooled (Plate I, right foreground).

These three machines are driven by electric motors

through line shafting and cut gear; each machine being fitted with a Heywood and Bridge patent friction clutch.

The screw vulcanising press is furnished with three steam-heated platens, 12 in. square, which are machined and polished on the working faces. Each platen is provided with separate steam and drainage connections and thermometer (Plate I, centre foreground).

The vulcanising pan, which is 18 in. deep and 18 in. in diameter, is so arranged that vulcanisation can be conducted either in live steam (by injecting steam into the pan) or in dry heat (by allowing the steam to enter only the jacket of the pan). It is fitted with the necessary steam and drainage connections, steam gauge, and thermometer (Plate III, Fig. 2).

The vacuum drier is one of Bridge's improved patent vacuum drying installations, of suitable size for experimental purposes; it is provided with steam-heated platens, condenser, receiver, and vacuum pump, the latter being driven by belts and pulleys from an electric motor.

The steam required for the working of the plant is supplied by means of a small vertical gas-fired boiler.

For the determination of the mechanical properties of vulcanised rubber, it is generally recognised that the machine designed by Herr Louis Schopper is one of the most efficient and satisfactory, and a machine of this type, with the latest improvements, has been obtained for testing purposes (Plate IV). The test pieces for use with this machine are cut from vulcanised sheet in the form of rings of standard dimensions by means of a series of circular cutting knives, and these rings are evenly rotated during the application of tension. The machine can be used to determine the breaking strain and the elongation at the breaking point; the elongation with fixed load; the load required for fixed elongation, etc. The machine is also fitted with an automatic apparatus for drawing hysteresis diagrams. The permanent or sub-permanent set of rubber after extension will be determined by means of a special apparatus, and other testing machines will be added during the progress of the investigation.

It is anticipated that work on these lines, carefully and

PLATE III.

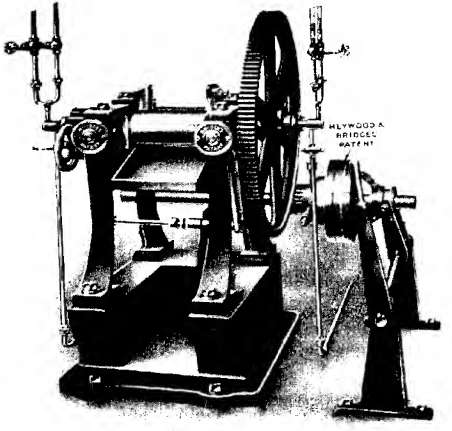


FIG. 1.—Mixing Machine.

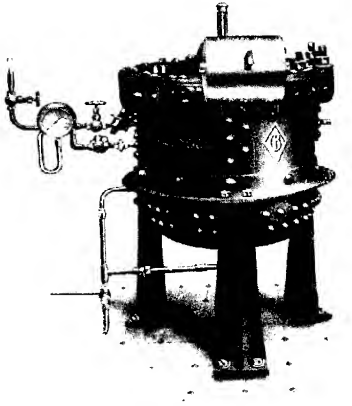
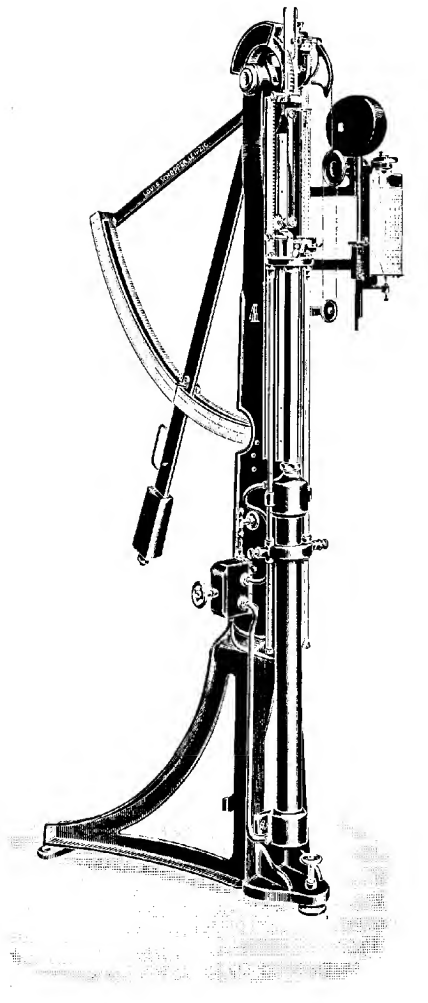


FIG. 2.—Vulcanising Pan.

PLATE IV.



Schopper's Rubber Testing Machine.

systematically conducted, will throw considerable light on the effect of different methods of preparation on the quality of the rubber, and will enable a method to be selected for use on plantations which will produce rubber of the highest possible quality for manufacturing purposes.

THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE, LONDON, 1914

ONE of the most remarkable commercial developments of recent years has been the increase in the capital employed in planting enterprises in the tropics. It has been estimated that at the present time the nominal capital of rubber-planting companies registered in the United Kingdom is approximately £100,000,000 sterling. This figure gives some indication of the magnitude of the world's interests in tropical planting, for it must be remembered that plantation rubber is only one out of numerous necessities of modern life for which the world is dependent on tropical agriculture. In this connection it is sufficient to mention such tropical crops as tea, coffee, cocoa, tobacco, coconut oil, cotton, jute, Sisal hemp, and cinchona, in the production of which large interests are involved. Equally important is the exploitation of tropical forest products, such as mahogany and other hardwoods, native rubber, gutta-percha, palm oil and palm kernels, tanning materials, and a host of less important products. It is not, perhaps, generally realised that the successful continuation of these industries has meant the creation in the tropics, and in the countries which possess tropical colonies, of official and other organisations for the conduct of scientific investigations to solve the innumerable new and difficult problems which have arisen in connection with agriculture and forestry in the tropics. It is nevertheless true to say that practically every tropical colony and every colonising country now possesses one or more organisations of this kind. Certain of the fundamental problems, which all these organisations are studying, are common wherever tropical agriculture is practised, and it is clear that some international means for the exchange of ideas on these

problems is desirable. It was with this object that the International Association for Tropical Agriculture, or, to use the official French title, l'Association Scientifique Internationale d'Agronomie Coloniale et Tropicale, was founded in 1905. This Association has its headquarters in Paris, and is represented in the countries concerned either by a National Section of the Association or by a Vice-President of the Association, or in some cases by an affiliated Society.

National Sections have so far been organised in France, Germany, Italy, and the United Kingdom.

The Association is governed by an International Bureau composed as follows:

MEMBRES DU BUREAU INTERNATIONAL DE L'ASSOCIATION

PRÉSIDENT EN EXERCICE (1910–1915):

M. le Prof. Dunstan, Directeur de l'Institut Impérial, Londres, Membre de la Société royale de Londres.

PRÉSIDENT SORTANT (1-ÈRE PÉRIODE D'EXERCICE, 1905–1910):

M. le Prof. J. L. de Lanessan, ancien Ministre, ancien Gouverneur Général de l'Indo-Chine.

VICE-PRÉSIDENTS:

Allemagne.—M. le Prof. A. Engler, Membre de l'Académie des Sciences de Berlin, Directeur des Musée et Jardin botanique royaux de Berlin, et de la Station botanique centrale pour les Colonies allemandes.

M. le Prof. Dr. Wohltmann, Conseiller privé, Directeur de l'Institut agricole de l'Université de Halle sur Saale.

Angleterre.—M. le Colonel Sir D. Prain, Directeur du Jardin royal, Kew, Membre de la Société royale de Londres.

Indes-britanniques.—M. Bernard Coventry, Conseiller agricole du Gouvernement.

Belgique.—M. Ch. Liebrechts, Conseiller d'État à Bruxelles.

M. E. Leplae, Directeur Général de l'Agriculture du Congo Belge, au Ministère des Colonies à Bruxelles.

M. E. de Wildeman, Directeur du Jardin botanique de l'État.

Brésil.—S.E.M. Olyntho de Magalhaes, Ministre du Brésil à Paris.

Egypte.—M. G. C. Dudgeon, Conseiller Agricole du Gouvernement au Caire.

Equateur.—S.E.M. le Dr. Rendon, Ministre de l'Equateur à Paris.

Espagne.—M. le Prof. Vincente Arche, Chef des Services de l'Enseignement et de l'Expérimentation agricoles, au Ministère de l'Agriculture, à Madrid.

M. E. Gomez Flores, Chef du Service agronomique des Canaries, à Las Palmas.

France.—M. le Myre de Villers, Ambassadeur, Président honoraire de la Société d'Acclimatation de France.

M. le Prof. Muntz, de l'Institut national agronomique, Membre de l'Académie des Sciences de Paris.

M. le Prof. Edmond Perrier, Directeur du Muséum national d'Histoire naturelle, Membre de l'Académie des Sciences de Paris.

M. le Prof. Prillieux, de l'Institut national agronomique, Membre de l'Académie des Sciences de Paris.

M. le Dr. Roux, Directeur de l'Institut Pasteur, Membre de l'Académie des Sciences de Paris.

M. Tisserand, Directeur honoraire de l'Agriculture de l'Académie des Sciences de Paris.

Italie.—S.E.M. le Prof. Nitti, Ministre de l'Agriculture, de l'Industrie, et du Commerce à Rome.

S.E.M. le Prof. Sanarelli, Secrétaire d'État au Ministère de l'Agriculture, de l'Industrie et du Commerce à Rome.

M. le Comte Sabini, Attaché commercial à l'Ambassade d'Italie à Paris.

Mexique.—S.E.M. de Mier, ancien Ministre du Mexique à Paris.

S.E.M. Olegario Molina, ancien Ministre de l'Agriculture à Mexique.

Pays-bas.—M. le Prof. H. J. Lovink, Directeur Général du Départment de l'Agriculture, des Indes néerlandaises à Buitenzorg.

Portugal.—M. le Prof. Freire d'Andrade, Directeur Général des Colonies, au Ministère des Colonies, à Lisbonne.

S.E.M. le Prof. Batalha-Reis, Ministre du Portugal à Saint-Pétersbourg.

M. le Prof. J. Henriques, Directeur du Jardin botanique de l'Université de Coimbra.

M. le Prof. de Monte-Pereira, ancien Directeur au Ministère des Colonies, à Lisbonne.

Russie.—M. le Prof. Boris de Fedtschenko, du Jardin botanique impérial de Saint-Pétersbourg.

Turquie.—M. le Prof. Hassib Bayindirly, Directeur de l'Enseignment agricole au Ministère de l'Agriculture, à Constantinople.

ADMINISTRATEUR-TRÉSORIER :

M. S. de la Rupelle, Secrétaire général de la Société générale pour favoriser le développement des Commerce et de l'Industrie, à Paris.

SECRÉTAIRE PERPÉTUEL :

M. le Dr. F. Heim, Professeur à l'école nationale supérieure d'Agriculture coloniale, et au Conservatoire nationale des Arts et Métiers.

Apart from the conduct of special enquiries and the publication of reports on these enquiries, the work of the Association consists principally in holding periodically International Congresses of Tropical Agriculture. The first of these was held in Paris in 1905, and the second in Brussels in 1910. The third Congress will be held in London at the Imperial Institute from June 23 to 30, this year. The organisation of the London Congress has been entrusted to the British Section of the Association, which has its headquarters at the Imperial Institute. The following Organising Committee was appointed early in 1913 and has now practically completed its preparations for the Congress :

ORGANISING COMMITTEE FOR THE CONGRESS IN LONDON

Chairman—Prof. Wyndham R. Dunstan, C.M.G., M.A., LL.D., F.R.S.

MEMBERS

Mr. M. Kelway Bamber, Government Chemist, Ceylon.
Mr. J. R. Blackwood, Director of Agriculture, Bengal.
Mr. J. R. Bovell, I.S.O., Superintendent of Agriculture, Barbados.
Mr. I. H. Burkill, M.A., F.L.S., Director of Gardens, Singapore.
Prof. P. Carmody, Director of Agriculture, Trinidad.
Mr. D. T. Chadwick, Director of Agriculture, Madras.
Mr. B. Coventry, C.I.E., Agricultural Adviser to the Government of India.
Dr. C. W. Daniels, Medical Adviser to the Colonial Office, London.
Mr. M. T. Dawe, late Director of Agriculture in the Territory of the Mozambique Co.
Prof. F. Debono, Inspector of Agriculture, Malta.
Mr. G. C. Dudgeon, Consulting Agriculturist, Ministry of Agriculture, Egypt.
Mr. P. R. Dupont, Curator, Botanic Station, Seychelles.
Dr. E. Goulding, Imperial Institute, London.
Mr. E. Ernest Green, late Government Entomologist, Ceylon.
Mr. W. S. Hamilton, Director of Agriculture and Industries, Punjab.
Prof. J. B. Harrison, C.M.G., Director of the Department of Science and Agriculture, British Guiana.
Mr. W. Hopkins, Director of Agriculture, Sierra Leone.
Mr. A. E. Humphries.
Mr. J. A. Hutton, Chairman, British Cotton Growing Association.
Mr. W. H. Johnson, Director of Agriculture, Southern Provinces, Nigeria.
Mr. C. H. Knowles, Superintendent of Agriculture, Fiji.
Mr. P. H. Lamb, Director of Agriculture, Northern Provinces, Nigeria.
Mr. L. Lewton-Brain, Director of Agriculture, Federated Malay States.
Mr. R. N. Lyne, Director of Agriculture, Ceylon.
Mr. A. C. MacDonald, Director of Agriculture, East Africa Protectorate.
Mr. J. MacKenna, Director of Agriculture, Burma.
Mr. J. S. J. McCall, Director of Agriculture, Nyasaland.
Mr. F. C. McClellan, Director of Agriculture, Zanzibar.
Mr. J. McSwiney, Director of Land Records and Agriculture, Assam.
Dr. E. A. Nobbs, Director of Agriculture, Rhodesia.
Lt.-Col. Sir D. Prain, C.M.G., C.I.E., LL.D., F.R.S., Director, Royal Botanic Gardens, Kew.
Mr. H. N. Ridley, C.M.G., F.R.S., late Director of Gardens and Forests, Singapore.
Mr. S. Simpson, B.Sc., Director of Agriculture, Uganda.
Mr. H. Hamel Smith, Editor of *Tropical Life*, London.
Mr. F. A. Stockdale, Director of Agriculture, Mauritius.
Sir Stewart Stockman, Chief Veterinary Officer, Board of Agriculture and Fisheries, London.
Mr. W. S. D. Tudhope, Director of Agriculture, Gold Coast.
Mr. W. T. Tutcher, Superintendent, Botanical and Forestry Department, Hong Kong.
Dr. F. Watts, C.M.G., Imperial Commissioner of Agriculture for the West Indies.
Dr. T. A. Henry, Imperial Institute, London,
Mr. Harold Brown, Imperial Institute, London, } Honorary Secretaries.

It will be seen that practically every tropical colony in the British Empire is represented on this Committee by its principal agricultural officer.

The committees of the various national sections are also actively engaged in promoting the interests of the Congress in their own countries and colonies.

Official notifications regarding the Congress have been issued by the British Foreign Office and by the Ministère des Affaires Étrangères in Paris, to the Governments of all countries possessing tropical colonies, and to States lying within the tropics, inviting them to support the Congress by appointing official delegates and in other ways.

A large number of institutes, associations, societies, chambers of commerce, and other unofficial bodies, British and foreign, interested directly or indirectly in tropical agriculture and colonial development, have already responded to the invitations issued by the Organising Committee, and will be represented at the Congress by special delegates.

Provisional Programme of the Congress

The Congress will be held at the Imperial Institute, South Kensington, London, S.W. It will open on Tuesday, June 23, and close on Tuesday, June 30, 1914.

In the order of business at the meeting, the morning sittings (10 a.m. to 1 p.m.) will be reserved for papers and discussions on subjects of general importance, each morning being devoted to a single subject; the afternoon sittings (3 to 5 p.m.) will be reserved for papers and discussions on special subjects.

Communications intended for the Congress may be made in English, French, German, or Italian; but the general language of the Congress will be English.

The following subjects are suggested for papers and discussion at the morning meetings:

Technical Education and Research in Tropical Agriculture.

Labour Organisation and Supply in Tropical Countries.

Scientific Problems of Rubber Production.

Methods of Developing Cotton Cultivation in New Countries.

Problems of Fibre Production.

Agricultural Credit Banks.

Agriculture in Arid Regions.

Problems in Tropical Hygiene and Preventive Medicine.

Papers for the afternoon meetings are invited on the following subjects:

I. Problems relating to Tropical Agriculture and Forestry.

II. The Cultivation and Production of—

Rubber.	Tea.
Cotton and Fibres.	Coconuts.
Cereals and other Foodstuffs.	Other Agricultural Products.
Tobacco.	Forest Products.

III. Plant Diseases and Pests affecting Tropical Agriculture.

Papers recommended for publication and Reports of Discussions will be published at the close of the Congress.

A considerable number of papers on these various subjects has been promised already by well-known experts in tropical agriculture, and there can be no doubt that the discussions which will take place at the Congress will be of great value to all interested in these matters.

Membership Subscriptions and Correspondence

The subscription for membership of the Congress will be £1, entitling members to admission to all meetings and receptions, and to receive the volume of printed papers and discussions, on publication. Those desiring to become members of the Congress are requested to send their subscriptions to the Organising Secretaries, Third International Congress of Tropical Agriculture, Imperial Institute, London, S.W., as soon as conveniently possible, in order that their names and permanent addresses may be registered.

A special circular, with the complete arrangements, will be forwarded to all registered members before the meeting.

THE CULTIVATION AND PREPARATION OF RICE. PART II

(*Continued from Vol. xi., p.* 655)

PESTS AND DISEASES

THE rice-crop is subject to the attacks of rats, birds, insect pests, and fungoid diseases, but many of these are only of local importance, and very few are sufficiently abundant to make any impression on the crop. The nature of the crop and the extensive area it occupies preclude the employment, on a large scale, of insecticides; consequently, in dealing with insect pests preventive measures play an important part. The fungoid diseases or "smuts" to which some varieties are subject are best controlled by growing immune varieties.

In dealing with rats, it is necessary to co-operate for the purpose of destroying them over large areas at one time, individual effort in dealing with this pest being practically useless. Trapping is the common method employed; many poisons are also in use, but these are not very effective in tropical countries. One of the most effective methods of eradicating rats is by using carbon disulphide. A teaspoonful of this compound poured into the entrance of a burrow, the mouth of which is then closed, is sufficient to asphyxiate all the rats there may be within. It is however a dangerous and inflammable substance, and should only be used by careful persons acquainted with its properties.

Insect Pests

Of a number of insect pests that attack rice the following are the more important:

The rice grasshopper (*Hieroglyphus banian*, Fabr.) has a wide and general distribution throughout India, and attacks other grasses, such as sugar-cane, as well as rice. It feeds upon the leaves of the rice-plant, but causes most damage by cutting through the upper part of the stalk, thereby causing the heads of grain to fall. The grasshopper hatches out from eggs which are laid in masses about 2 in. below the surface of the soil, usually in the banks

or bunds surrounding rice-fields, but never in the fields themselves. About one half of the year, the dry season, is spent in the egg stage; during the other half the grasshopper lives above ground. During a great part of their development the insects feed on the grass on the bunds bordering the rice-fields, whence they migrate to the rice-fields themselves. The best time for combating them is during the early stages, as soon as they emerge from the eggs and while they are still living on the bunds. Bagging is the most efficient method of destroying them. This method consists in dragging over the bunds a bag of cotton cloth, by which means large numbers of grasshoppers are caught. The captured insects are killed either by crushing them or by emptying the bag into a vessel containing water mixed with a small quantity of kerosene. The bags used successfully in Mysore for this purpose measure about 7 ft. in length and 3 to 4 ft. by 1½ to 2½ ft. at the mouth. On each of the two narrow sides of the mouth of the bag, a bamboo pole 3 to 4 ft. in length is fixed. The poles keep the mouth of the bag open and taut when in use and also serve as handles for dragging the bag over the ground. Two men are necessary to drag the bag, and it is essential that they should move as quickly as possible while doing so. It is important that the bagging should be done early, when, if concerted action be taken, much can be done towards reducing the damage caused by this pest. An experimental bagging in Mysore in 1911 resulted in a catch of 43,000 grasshoppers in about one hour, with one bag, over about 185 yards of bund, which bordered at least 2 acres of rice-fields. (Cf. *Bulletin* No. 1, 1911, *Entom. Ser., Dept. Agric., Mysore State*, and *Bulletin* No. 67, 1913, *Dept. Agric., Madras*).

The rice hispa (*Hispa armigera*, Oliv., syn. *H. œnescens*, Baly), a small blue-black beetle covered with spines, occasionally causes damage to the rice crops in India. It sometimes appears in enormous swarms, and then causes wholesale destruction. Usually it feeds on the young rice-plants in seed-beds or in newly planted fields; it eats the cellular tissue but rejects the fibrous vascular bundles, and as a result of its attacks the plants assume a white and

withered appearance. The eggs are laid singly in the tissue of the leaf, and the whole life of the beetle is spent within the leaf until the mature insect emerges. Wild jungle grasses are the normal food plants of the beetle, and from these it flies to the rice-fields. Preventive measures are important in dealing with this pest, and it is necessary to watch seed-beds closely in order to prevent eggs being deposited on the seedling rice-plants. Sometimes it is possible to destroy it in its breeding places in the jungle before it migrates to the rice-fields; at other times, by hastening or delaying the time of transplanting, the seedlings may escape from its attacks. At Sibpur Experimental Farm seedlings were protected by being dipped in a solution of asafœtida before being transplanted. Submerged lowland rice is attacked in preference to rice on higher land, and cultivators, in view of this, sometimes run off the water from their fields in order to induce the beetles to leave. When present in large numbers the beetles may be caught in bags as described above. Some soft-leaved varieties of rice are found more liable to attack than rough, hard-leaved sorts, and where this pest is prevalent the latter should be grown.

The rice-bug (*Leptocorisa varicornis*, Fabr.), a slender green insect with long antennæ, injures rice and other cereals by sucking the milky juice from the developing grain, thereby causing the ears to turn white. The bugs hatch out from eggs which are laid on jungle plants and also on the leaves of rice. The eggs are oval, somewhat flattened, black and seedlike in appearance, and are deposited in groups of ten or more. The young insects are wingless, but wings develop gradually, and mature insects may be found actively flying in the rice-fields. If early and concerted action be taken, and large areas treated at the same time, the method of bagging suggested for controlling rice grasshoppers (p. 86) is found to be efficacious in checking this pest. The simplest plan is to draw the bag quickly through the growing rice, by which means large numbers of both winged and wingless forms are captured. As the full-grown bugs are capable of flying from one field to another, large areas require

to be swept simultaneously. The larvæ of the six-spotted tiger beetle (*Cicindela sexpunctata*, L.), a predaceous beetle common in the rice-fields of Bengal, feed on the rice-bug, and help to keep it in check.

The rice stem-borer (*Schœnobius bipunctifer*, Wlk.), a small moth which lives in the stem of the rice-plant during the larval stage, causes damage to the flower-spike by feeding above the upper node of the stem, as a result of which the flower-spike becomes withered and bleached. After reaching the top of the stem the larva emerges and constructs for itself a bag-like covering made from a portion of the leaf of the rice-plant. In this it remains for about a week, and then re-enters the stem of the plant near the base. It there spins a cocoon and undergoes metamorphosis, and in about ten or twelve days' time the mature moth emerges. There are no methods of controlling this pest practised, but it is suggested that, as the affected plants are readily distinguished owing to the bleached appearance of the flower-heads, they should be pulled up and burnt while still containing the pupa of the moth. If this were practised thoroughly over large areas for a few seasons, this pest would no doubt eventually be eradicated. The use of light-traps at night to attract the moths has also been suggested.

The caterpillar of *Nymphula depunctata*, Gn., a small moth, is frequently a serious pest of the rice-plant in Southern India. It is semi-aquatic in habit, and lives in cases constructed of rolled pieces of leaf. It causes damage by feeding on the leaves and tender green tissues. The native treatment consists in dragging branches over the fields to dislodge the cases and draining off the water; but as the pest is frequently found in low, water-logged areas, which cannot be drained, this treatment is not always possible.

The rice weevil (*Calandra oryzæ*, L.), a small insect about $\frac{1}{8}$ in. in length, with a prominent curved snout, attacks rice and other grain stored in warehouses. It is abundant in India, and is known throughout the rice-producing countries. It may be killed by treating the grain with carbon disulphide at the rate of 1 oz. per

cubic foot of space for twenty-four hours; but, as noted above, great care must be taken in using this highly inflammable and explosive substance.

The rice water-weevil (*Lissorhoptrus simplex*, Sarg.) is the most serious insect pest of the rice crop of the southern states of North America. The adult weevils measure about 3 mm. in length, and are capable of moving about freely in water. The larvæ feed on the roots of the rice-plant, and the adult insects cause damage by eating the leaves. Deep and stagnant water on the rice-fields encourages the development of this pest, while dry conditions check its spread. It has been found advantageous where this pest is present to merely soak the soil instead of flooding the rice-fields, especially during the early stages of growth. The practice of drawing off the water from the infected fields and allowing them to become somewhat dry before re-flooding them tends to check the ravages of this pest during the early stages of infection; good cultivation also greatly assists in combating this weevil, as weeds which would serve as host-plants are thereby eliminated, and the rice-plants, rendered more vigorous, are better able to withstand its attacks. The levelling of the surface of rice-fields so as to do away with depressions which would hold stagnant water and serve as breeding grounds for the weevil, is a necessary precaution.

Caterpillars.—Young rice-plants are very liable to be attacked by caterpillars of several species, and in dealing with these, as with other insect pests, preventive measures are more important than remedies. The normal food of caterpillars is the vegetation of the banks and waste lands surrounding rice-fields. The importance of cutting down and burning this is therefore obvious, as by this means large numbers of caterpillars are destroyed and their excessive increase checked. If possible, infested land surrounding rice-fields should be rolled in order to crush the caterpillars, and so prevent their migrating to the rice-fields. An effective bar to the passage of swarming or migrating caterpillars is a trench about 1 ft. deep, opened across their path; if the side of the trench nearest the caterpillars be made gently sloping and the opposite

side upright or concave, the caterpillars will enter the trench, but will be unable to crawl up the concave side. If pits, 1½ to 2 ft. deep, be opened at intervals along the bottom of the trench, many of the caterpillars will fall into them in seeking a way out, and may then be easily destroyed. Infected portions of rice-fields may be isolated in the same way, or by means of water channels. A channel of water surrounding rice-fields or seed-beds affords an effective barrier against caterpillars, but the channel must be kept free from weeds, which, if present, would form a bridge for the caterpillars. When present in small numbers only, caterpillars may be controlled by hand picking. This should be done early, as soon as the first brood appears, otherwise the second brood will, under favourable circumstances, be more numerous and more difficult to cope with. On the bunds, if found in masses, they may be destroyed by dusting them with quicklime.

Ufra Disease.—This disease has been known for some years in the delta region of Eastern Bengal, but is said to have increased in virulence in recent years. Three stages or forms of the disease are recorded: (1) the plants are affected before the ears form, and the leaves assume a reddish or brownish appearance and ultimately wither; (2) the upper portion of the plants becomes swollen and the inflorescence remains enclosed within the sheath; (3) the ear emerges from the sheath, but the peduncle becomes shrunken and the grain fails to set. In all these there is a reddish or brownish discoloration of the plant confined to a limited area, usually about the nodes, and often only in the upper parts of the plant. The disease is believed to be due to an eel-worm (*Tylenchus angustus*, Butler), of minute size, scarcely visible to the unaided eye. On diseased plants this worm is found in the early stages occupying small brown patches on the leaves and culm, and as the crop approaches maturity large numbers are found on the peduncle of the ear, at which points the culm becomes blackened, and shrunken to about the thickness of a thread.

This disease is found chiefly on broadcasted *aman* rice, and the conditions under which this crop is grown

probably favour this disease. A long stubble is left after harvesting the crop, and this is trampled down by cattle and, at the time of sowing a new crop, is ploughed in; either the crop or stubble is therefore on the land for the whole year. As a preventive measure it is suggested that the land be ploughed as soon as the crop is harvested, and the straw and stubble burnt in order to thoroughly clean the land between successive crops (see *Bulletin* No. 34, 1913, *Agric. Research Inst. Pusa*).

Fungoid Diseases

"Blast" or "rotten-neck" (*Piricularia oryzæ*, Cav.), a world-wide rice disease, attacks the rice-plants at the sheath nodes, where the blade of the leaf joins the sheath, and more frequently at the lowest joint of the head of grain (the "neck"). The chief damage caused by this disease is the failure of the grain to fill on the diseased stalks, and the production of light grain of poor quality. Many of the diseased heads of grain bend over or fall off by their own weight when the disease occurs in the "neck" region. The withholding from the soil of rich nitrogenous manures, and the removal by burning of all organic refuse after harvesting the crop, are preventive measures that should be observed. In Italy this disease is said to have been eradicated by the cultivation of resistant varieties.

False or green smut (*Ustilaginoidea virens* [Cke.] Tak.) attacks the rice-grain, which, as a result, becomes large and swollen, and filled with a compact, white mass bordered by a yellowish-brown layer, and on the outside coated with a dark green powder. Usually this disease is not serious, and only a few grains per head of the affected plants are attacked (*loc. cit.*).

Black smut or bunt (*Tilletia horrida*, Tak.) converts the grain of rice into dark, powdery masses of spores, but produces little change in the external appearance of the grain. The mycelium of the fungus lives within the stem of the rice-plant, and infection probably takes place during the seedling stage. In South Carolina this disease is said to have been stamped out by selecting the seed intended for sowing by the salt-water method. The seed

is immersed in salt water, and the infected seeds, which are lighter than the sound grains, are floated off. The remaining seed is then treated for twenty-four hours in a mixture of "liver of sulphur" and water (1½ lb. to 25 gallons of water) before sowing. Seed from smut-infected fields should not be used for sowing, but in cases where this is unavoidable it should be subjected to the above treatment or should be steeped in a solution of formalin (½ pint of 36 to 40 per cent. water solution of formalin to 20 gallons of water) before being sown. The seed should remain in the solution about half an hour, and should be stirred repeatedly during the immersion, the seeds that float being skimmed off.

Light or Sterile Grains.—A large proportion of the light and sterile grains found in rice results from the attacks of insects, but a certain quantity of light grain is believed to be due to the attacks of *Sclerotium oryzæ*, Catt., a parasitic fungus found on rice-plants in the Madras Presidency, India, and also recorded as occurring in Japan and Italy. This fungus attacks the base of the stem of the rice-plant, causing discoloration of the lowest internode and the decay of the lower leaf-sheaths. The infected plants are markedly late in tillering, and develop a number of green, sterile shoots from the basal nodes of the stalks, and the ears, although normal in appearance, do not mature a full proportion of their grain. The life-history of this fungus is imperfectly known, and the amount of damage for which it is responsible has not yet been estimated, but in all probability it is not great.

Preparation of Rice

Rice Milling.—The grain, as separated from the rice-plants by thrashing, is known as "paddy" (padi). In this state it is enveloped in a close-fitting husk or hull, which has to be removed in order to render the grain suitable for consumption. The usual native method of husking rice is by pestle and mortar, the chaff or hulls being subsequently separated from the grain by winnowing. In some parts of India the pestle is attached to a beam which is worked by the foot of the operator; in other

countries, as in some parts of Japan, an overshot water-wheel supplies the motive power. To facilitate the removal of the husk, paddy is sometimes partially boiled, and then dried in the sun before treating by pestle and mortar; such rice is termed "parboiled rice." Husking without boiling is, by primitive methods, a tedious and laborious operation. Transportable machines operated by either hand-, horse-, or bullock-power, are now on the market, capable of husking paddy, and these will in all probability eventually oust the more primitive appliances for local use. Similar machines for winnowing and grading the grain are also available. In all the important rice-exporting countries there are large rice-mills, the most important being those in Burma, which are fitted with elaborate power-driven machinery by which paddy is treated for export.

The process of milling is briefly as follows: The paddy is first sifted in order to remove dirt or other foreign matter with which it may be mixed; the husks are then removed by passing the grain through milling stones or a system of hullers, screens, and winnowing-machines. The husked rice is next milled in cones to produce "white rice," during which process the pericarp is removed with much of the aleurone-layer of the endosperm, and also the embryo or "germ," and these together constitute rice "bran" or meal. It is finally polished by being placed in cylinders of wood and wire gauze fitted inside with revolving rollers covered with sheep-skin, which remove all floury matter from the grain, and give it a fine, smooth surface. Powdered talc (French chalk) or steatite is sometimes used as a polishing material during this process. The floury matter removed by polishing is known as "rice polish." The polished grains are finally screened into various grades, and a percentage of the broken kernels is removed, which varies according to the quality of rice that is being prepared; for example, in Rangoon there are five qualities of white rice recognised in the trade, the proportion of broken to whole grains being from 25 per cent. in the highest quality to 55 per cent. in the lowest. Practically all the phosphates in rice are contained in

the pellicle which is removed by the polishing process. The elimination of the phosphates greatly diminishes the nutritive value of the grain, and an exclusive diet of polished rice is by some authorities held to be responsible for the disease known as beri-beri.

Large quantities of incompletely husked rice, known as "cargo rice," are shipped from producing countries. The proportion of unhusked grain varies from 5 to 20 per cent. according to the extent of milling it has undergone. Cargo rice is largely shipped to European countries, and also in smaller quantities to America and Australia, where it undergoes further milling according to local requirements. It is probable that protective tariffs as well as local requirements are responsible to a certain extent for the large quantities of rice imported in this partially prepared form instead of in the form of white rice suitable for immediate consumption. Most of the rice consumed in the United Kingdom is obtained from India. Large quantities are also imported from the Netherlands, where rice-milling is an important industry, the rice being imported mainly in the form of cargo rice from Java, Rangoon, Bassein, Saigon, and Japan.

The following table, compiled from the *Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions*, 1912 [Cd. 6810], gives the quantities and values of whole and cleaned rice imported into this country during the years 1910–12, and also the countries whence the imports were consigned:

	1910.	1911.	1912.	1910.	1911.	1912.
	cwts.	*cwts.*	*cwts.*	£	£	£
Netherlands	566,912	564,590	447,280	351,971	352,489	313,078
Germany	143,980	184,490	93,254	79,205	104,926	56,561
Italy	7,000	14,670	41,549	6,507	10,210	34,974
Siam	342,401	125,583	70,660	152,958	61,388	41,446
Japan (including Formosa)	106,810	64,930	18,420	69,838	44,943	15,182
United States of America	9,850	25,766	5,270	11,138	24,348	5,475
Other foreign countries	99,230	76,824	38,554	38,085	44,855	24,714
British India	2,212,254	1,827,971	2,394,942	993,227	866,822	1,405,886
Other British Possessions	20	540	10	14	252	10
Total	3,488,457	2,885,364	3,109,939	1,702,943	1,510,233	1,897,326

The re-exports of whole and cleaned rice from the United Kingdom (foreign and colonial merchandise) for the years 1910–12, and their values, together with the principal countries to which the exports were consigned, are as follows:

	1910.	1911.	1912.	1910.	1911.	1912.
	cwts.	*cwts.*	*cwts.*	£	£	£
French West Africa	11,508	14,397	14,444	5,470	7,128	9,314
Portugal	11,160	13,448	39,801	5,043	6,439	23,668
Cuba	816,722	738,699	661,716	389,883	370,481	419,826
Brazil	57,436	30,481	28,791	33,420	21,465	25,437
Other foreign countries	107,715	134,221	197,090	56,241	71,376	124,916
British West Africa	91,920	82,223	73,186	44,175	41,698	45,379
Canada	32,747	30,368	20,960	14,603	15,760	13,742
British West Indies	198,706	193,376	136,236	93,235	98,178	77,220
Other British Possessions	23,874	19,393	24,731	12,594	11,381	17,257
Total	1,351,788	1,257,606	1,196,955	654,664	643,906	756,759

A relatively small quantity of rice is milled in England, and that mainly for export. The following table, taken from the *Annual Statement* above quoted, gives the quantities and values of rice, cleaned or milled in the United Kingdom, exported during the years 1910–12, and also the principal countries to which the exports were consigned:

	1910.	1911.	1912.	1910.	1911.	1912.
	cwts.	*cwts.*	*cwts.*	£	£	£
French West Africa	17,296	23,154	14,666	8,424	11,606	8,512
Portugal	18,154	23,206	18,710	9,591	12,610	12,066
Liberia	12,526	11,162	13,077	6,050	5,562	8,242
United States of America	35,764	36,855	28,856	17,717	20,664	18,345
Cuba	53,325	50,880	78,502	25,884	26,374	46,085
Brazil	84,399	51,890	44,224	41,421	28,533	28,913
Other foreign countries	145,917	133,274	139,837	74,785	69,038	85,519
Gold Coast	93,816	77,694	89,920	45,162	38,760	49,936
Southern Nigeria	174,988	166,498	143,234	86,411	83,560	83,033
Canada	36,873	42,377	45,296	21,233	26,019	34,526
British Honduras	15,669	18,804	15,437	7,604	9,296	8,733
Other British Possessions	109,016	82,063	38,770	54,444	41,929	23,080
Total	797,743	717,857	670,529	398,726	373,951	406,990

From the miller's point of view, in order to produce white rice of the finest quality, the first essential is a supply of good, bold grain of regular size. There is no economical method of grading large quantities of paddy according to size of grain, and when mixed samples have to be milled,

the large grains are frequently broken owing to their receiving too great pressure during the hulling and grinding processes, while the small grains escape milling.

The presence of unmilled and broken grains in a sample of "finished" rice lowers the commercial value of the latter considerably, and to eliminate them adds to the cost of production. Paddy or cargo rice always commands a higher price when the grains are uniform in size, and the necessity for keeping varieties distinct that differ in size or shape of grain is obvious.

The separated products obtained as a result of rice-milling are as follows:

"*Head*," "*table*," *or* "*special*" *rice*—consisting of whole grains of a uniform size.

Straights—mostly whole grains, but of a grade slightly below the preceding quality.

Screenings—broken rice, of which there are several grades, known as *smalls*, *points*, *brewer's rice*, and *fannings*. Broken rice is used for making ground rice or rice-flour, for brewing, starch-making, and other technical purposes.

Polish—a flour-like material (sometimes incorrectly spoken of as rice-flour) scoured from the surface of the grain during the polishing process. It is used as a cattle food.

Rice bran—consisting of the outer skin of the grain after the husk has been removed, together with the aleurone layer and the "germ." Used for feeding cattle.

Rice husks or hulls—the outer chaff-like covering of the paddy. It is used as fuel in the rice-mills, and as a packing material, but to a large extent is waste. Experiments have been made with a view to the utilisation of this product, and it has been mixed with crude petroleum and pressed into fuel-blocks; it has been suggested as a substitute for sawdust, and as a "filling" material in linoleum manufacture. In British Guiana it is mixed with molasses, and is exported as a cattle food.

The following percentage analyses of the products enumerated above are taken from Bailey's *Cyclopædia of American Agriculture*:

Product.	Proteins.	Ash.	Fat.	Carbo-hydrates.	Crude fibre.
Commercial or polished rice .	7·52	0·73	0·38	78·05	—
Rice polish	11·06	8·45	5·92	65·97	—
,, bran	9·88	11·55	9·21	52·63	—
,, hulls	3·50	18·29	0·4	41·80	37·50
,, straw	3·31	14·64	0·59	33·31	32·01

The following table, taken from *The Agricultural Ledger*, 1908–9, No. 5, gives the average percentage results of the analyses of 159 samples of Indian rice:

Locality.	No. of Samples.	Water.	Pro-teins.	Fat.	Carbo-hydrates.	Crude fibre.	Ash.
Bengal . . .	14	11·10	7·51	0·40	79·82	0·44	0·73
,, . . .	12	12·37	7·09	0·40	78·86	0·48	0·80
E. Bengal and Assam	16	11·19	7·67	0·53	79·21	0·58	0·82
Burma. . . .	10	11·54	7·54	0·98	78·59	0·58	0·77
Cuttack . . .	11	10·92	6·58	0·31	80·81	0·35	1·03
Central Province. .	7	9·05	6·68	0·88	82·05	0·42	0·92
United Provinces .	10	10·03	7·44	2·83	77·14	1·00	1·56
Nepal. . . .	13	11·28	7·50	0·85	79·13	0·32	0·92
Punjab . . .	14	12·89	6·98	0·36	78·63	0·39	0·75
Bombay . . .	16	12·61	7·69	2·65	74·63	0·89	1·53
,, . . .	14	13·15	7·27	2·56	74·90	0·74	1·38
Madras . . .	11	8·94	7·10	0·74	81·54	0·43	1·25
,, . . .	11	11·69	6·81	1·03	79·00	0·49	0·98

Rice Production in the British Empire and Egypt

India.—It is estimated that about 35 per cent. of the cultivated area of British India is under the rice-crop. The principal rice-producing provinces are Bengal, Madras, Assam, Burma and the Central Provinces.

The total rice-crop for the year 1910–11 was estimated at 27,896,000 tons, and for 1911–12 at 26,099,600 tons, as against an average of 23,167,300 tons for each of the preceding five years. India exports more rice than any other country in the world. In the year 1911–12 the total quantity of rice exported amounted to 2,625,000 tons, valued at £19,371,000; of this quantity Burma contributed 73·6 per cent. Burma is less subject to crop disaster than are other parts of India; and as the rice area in Burma per head of population is 0·832 of an acre, as compared with 0·509 in Eastern Bengal and Assam, and 0·496 in Bengal, there is a larger surplus available for export. Burma rice is exported from Rangoon, and in the European trade "Rangoon rice" is now the standard, other descriptions being quoted in relation to it. Indian rice is mainly exported in the months

of January to April, and arrives on the western markets almost simultaneously with supplies from Saigon, Siam, and other sources. The result of this is a depression in price, owing to the market being glutted. For Java rice, which comes on to the market some six months later, much better prices are usually obtained; and this is, in a large measure, due to the smaller supplies on the market. In view of this fact, it has been suggested that modern grain elevators should be adopted in which to store the rice in Burma, and so spread the trade over a longer period of each year. (Cf. *Burma Rice*, by the Director-General of Commercial Intelligence, India, 1912.)

Ceylon.—Rice is the staple article of food of the native population in Ceylon, and the cultivation of rice is the principal industry of the village agriculturist. The total area under rice in 1910-11 was estimated roughly at 680,574 acres. A large part of this area depends entirely on the rainfall, and this renders rice cultivation somewhat precarious in some districts. The irrigation schemes at present being carried out by the Government will, it is hoped, render a larger area independent of the natural rainfall for rice cultivation. The local production of rice for the year 1911 amounted to 10,219,746 bushels of paddy, equivalent to 8,108,058 bushels of rice. The local output is, however, never sufficient to meet half the demand of the population, including the large number of immigrant coolies employed on the planting estates, and large quantities are annually imported. For the year 1911 the quantity imported to supplement the local supply amounted to 11,775,442 bushels of rice and 1,190,287 bushels of paddy. The bulk of the import comes from India.

Federated Malay States.—Rice cultivation is an important native industry in the Federated Malay States, but the country produces only a small proportion of the amount consumed locally. According to the *Report of the Director of Agriculture*, 1911, the area under rice for the year 1911-12 was 103,278 acres, as against 119,224 acres for the preceding year. The reduction in area was mainly due to the drought experienced in the early part of 1911, which continued over the planting season, and resulted in considerably reducing

the area planted in those districts dependent on rain. In 1912–13 the area under rice had increased to 122,751 acres. The yield of rice in 1912 was 2,645,134 bushels.

Large areas of flat, low-lying land in the Krian district of the State of Perak are now irrigated by the Krian Irrigation Works, the first extensive irrigation scheme undertaken by the Government in these States. Under this scheme, some 60,000 acres of land are irrigated, and in consequence the rice area in this district has more than doubled since 1904. Numerous river valleys throughout the States have been rendered suitable for rice cultivation by native systems of irrigation. In the Krian district the Department of Agriculture has recently issued rules regulating the planting of rice, and fixing a date by which all planting operations must be completed. This was necessary in order to facilitate the working of the irrigation scheme, but it is also hoped that it will reduce the damage done by insect pests by restricting the time during which fresh broods could arise. Experiments are being carried out by the Department with a view to improving the drainage of irrigated rice-lands and the native methods of cultivation. At Kuala Kangsar, seed selection experiments are now in progress, as a result of which it is hoped to improve the yield and milling qualities of the native varieties.

Fiji.—In Fiji the cultivation of rice is entirely in the hands of Indian immigrants, who cultivate the crop for their own food supply, but the local output does not meet the demand, and there is a considerable annual import. For the year 1912 the import of rice amounted to 2,376 tons, valued at £27,381, and this is likely to be considerably increased in the future, when the opening up of estates will result in the introduction of a larger rice-eating population. There are large areas of swampy land that might be rendered suitable for the production of lowland rice, and also drier areas at higher elevations suitable for the cultivation of upland varieties.

Australia.—In Queensland rice was successfully grown for some years, but during recent years it has been almost abandoned for more remunerative crops. In 1892–3 the

area under rice was returned at 1,113 acres, but this had fallen to 7 acres in 1908, whilst there was no record of the crop in 1909; in 1911, 15 acres were under rice.

In the Northern Territory there were 12 acres under rice in 1910–11, and 2 acres in 1911–12, but there are large areas of land suitable for rice cultivation available.

Egypt.—In Lower Egypt rice is cultivated chiefly in the Provinces of Sharqia, Behera, and Daqalia; in the north of Gharbia, especially near Damietta; and in Upper Egypt, chiefly in the Fayum. In the neighbourhood of Gharbia particularly it is grown for its own sake, but in other localities it is cultivated chiefly as a rotation crop with cotton, berseem, and wheat on lands that have become salty owing to imperfect drainage. The large quantities of water employed for the rice-crop, and the alternate draining and flooding that the crop receives during its growing period, tend to sweeten the land by removing the salts that are injurious to most other crops.

The area under rice for the year 1912–13, according to the *Annuaire Statistique de l'Égypte*, 1913, was 242,367 feddans (1 feddan = 1·038 acres), of which 229,150 were in Lower Egypt, and 13,217 in Upper Egypt. The varieties of Egyptian rice are grouped into three classes, according to the quality of grain and their periods of growth: "Sultani," a white grain of high quality, occupying the land for from 5½ to 6 months; "Yamani," white seeded, occupying the land for from 3½ to 4 months, and requiring little water; and "Sabeini," a dirty white grain, requiring much water, and occupying the land for only 2½ to 3 months. Two crops a year are obtained in Lower Egypt, and these are known as flood (nili) and summer rices. The former are sown in May, and the latter in August.

There is a considerable import and export trade in rice in Egypt, as is shown by the following table, taken from the source above quoted:

Imports of Rice

From	1910. *Kilos.*	1911. *Kilos.*	1912. *Kilos.*
British Possessions .	30,554,788	34,821,091	33,825,492
Other countries .	10,357,782	3,662,683	516,729
Value . . .	£E325,813	333,294	365,031

Exports of Rice

To	1910. *Kilos.*	1911. *Kilos.*	1912. *Kilos.*
Turkey	20,367,391	17,541,257	16,987,569
Other countries . . .	8,446,519	12,214,557	8,154,567
Value	£E288,298	287,637	284,271

Sudan.—In the Sudan rice has been grown experimentally during the past few years in the Bahr el Ghazal Province, and in consequence of the favourable results obtained rice is now being grown to supply the troops stationed in that district. Experiments have also been conducted in the Upper Nile Province and in Southern Kordofan.

There is a considerable import of rice into the Sudan, the supplies being drawn chiefly from India, Egypt, and Italy. The import for the year 1912 amounted to 3,186,843 kilos, valued at £E28,683, as against 2,234,615 kilos, valued at £E17,829, in 1911.

Nyasaland.—It has been stated that a considerable quantity of rice is grown by natives at Kota Kota on the lake shore, and that the industry could be extended if a market could be found for the product in Europe. The prepared rice from Kota Kota is sold in Zomba at £5 6*s.* 8*d.* per ton, but it is thought that it could probably be produced on the marshes of the Lower River at from £3 to £4 per ton, which would bring the price in London to £5 10*s.* or £6 10*s.* per ton, allowing for transport at the rates now charged for maize. The unhusked rice could be exported at a cheaper rate. The total rice crop in the Protectorate in 1912 amounted to 824 tons, and the 1913 crop was estimated at 1,511 tons.

A sample of unhusked rice (paddy) and one of husked rice grown in Nyasaland were received at the Imperial Institute in January 1910. They were as follows:

No. 1. "Nyasaland paddy."—This consisted of clean, unhusked rice, from which the husk was easily removable, leaving rice grains, which were white, and of good plump appearance.

No. 2. "Nyasaland native-prepared rice."—This sample consisted of white rice, free from husk. The grains were rarely whole, although in most cases only small fragments had been broken off. The rice was covered with a

yellowish dust, which was readily removable on "polishing" in a soft calico cloth. The "polished" rice so prepared was of good appearance and colour.

The paddy was submitted for valuation to a firm of brokers, who stated that it would not interest millers in this country, and could only be sold here for feeding purposes at 5*s.* to 5*s.* 6*d.* per cwt. (March 1910), but that there is a demand for paddy on the Continent.

The brokers considered that the large proportion of broken grains in the sample of prepared rice diminished its value, but that consignments of similar character should realise 8*s.* to 8*s.* 6*d.* per cwt., packed in new bags, c.i.f. United Kingdom ports (March 1910). There would, however, be a better market for this rice in a partially cleaned condition, at 7*s.* to 7*s.* 6*d.* per cwt. (March 1910), as this quality suits millers better than more highly cleaned grain.

The brokers stated that the sample was extraordinarily mixed, and included grains having the characters of Java, Patna, Garden Siam, and Burma rice. They added, however, that the material would greatly interest millers in this country if properly prepared for the market.

Zanzibar and Pemba.—Zanzibar at present produces but little rice, and large shipments are annually imported from Rangoon. The hot, swampy valleys of the island of Pemba could be made to produce abundant crops of rice, but comparatively little is grown at the present time, although formerly rice was an important article of export.

The following eight samples of unhusked rice from Pemba were received at the Imperial Institute for examination in May 1912:

No. 1. "*Pemba Rice, Hill var.* (*Kikego*)."—This consisted of rice in the husk (paddy), the colour of which varied from light straw to pale brown. The length of the grains varied from medium to long, and the width from medium to broad. The rice was in good condition, clean, and free from extraneous matter. There were signs that the sample had been attacked very slightly by insects, and a small proportion of weak, discoloured grain was present.

On being husked and cleaned, the paddy yielded on the whole hard, fairly clear, translucent grain, of good

appearance, with a very slight yellow tint. About 30 per cent. of the grain had a red cuticle which could be removed by cleaning, yielding translucent or, in some cases, white, opaque grains. The husked grains measured from 6 to 7 mm. in length, and from 2 to 2·5 mm. in width.

No. 2. "*Pemba Rice, Valley var.* (*Sifala*)."—This consisted of rice in the husk, which was of pale straw colour; the grains were broad and of medium length. The sample was clean, of good appearance, and free from extraneous matter and insect attack.

On being husked and cleaned, it yielded for the most part moderately hard, fairly clear grains, translucent on the whole, though a considerable number were in parts white and opaque. About 20 per cent. of the husked grains had a red cuticle similar to that described in the preceding sample ("Kikego"). The cleaned rice had a very slight yellow tint. The husked grains averaged 6 mm. in length and 2·5 mm. in width.

No. 3. "*Pemba Rice, Valley var.* (*Sindano*)."—This sample consisted of rice in the husk, which was of a straw colour. The grains were long and slender in shape. The sample was in good condition, clean, and free from extraneous matter, but there were signs of insect attack, and a small proportion of weak, discoloured grain was present.

On husking and cleaning the rice yielded hard, clear, translucent grains, having a very slight yellow tint. The husked rice contained 2 per cent. of grain, having a red cuticle which could be removed by cleaning, yielding slightly opaque grains. The length of the husked grains was 7 to 7·5 mm., and the width 2 to 2·5 mm.

No. 4. "*Pemba Rice, Valley var.* (*Sena*)."—This consisted of unhusked grains, varying in colour from a straw tint to pale orange brown. The grains were broad, and varied in length from medium to long. They were in good condition, clean, and free from extraneous matter. The sample showed some signs of insect attack and contained a small proportion of weak grains.

The rice when husked and cleaned yielded hard, fairly clear grains of good appearance and of a very slight yellow tint. The husked rice contained approximately

4 per cent. of grains with a red cuticle, similar to those in the preceding samples. The length of the husked grains was from 6 to 6·5 mm., and the average width was 2·5 mm.

No. 5. "*Pemba Rice, Valley var.* (*Sifala ekundu*)."—This consisted of rice in the husk, mostly reddish-brown but in a few cases of pale straw colour. The grains varied in size but on the whole were rather thin. They were in good condition, clean and free from extraneous matter.

The rice when husked and cleaned yielded for the most part fairly hard, translucent grains of a slight yellow tint. The husked rice contained about 13 per cent. of red grains, which on cleaning yielded either translucent or white opaque grains. The average length of the husked grains was 6 mm., and the average width 2 mm.

No. 6. "*Pemba Rice, Hill var.* (*Halua*)."—This consisted of rice in the husk. The grains were rather short and broad, and of a pale straw colour. The sample showed slight signs of insect attack and contained a small amount of weak, discoloured grain, but it was clean and free from extraneous matter.

The rice when husked and cleaned yielded moderately hard grains, many of which were white and opaque on one side. A considerable number of translucent grains of a slight yellow tint were also present. The husked rice contained 7 per cent. of red grains, which on cleaning yielded chiefly white, opaque grains. The length of the husked grains was from 5 to 6 mm., and the width from 2·5 to 3 mm.

No. 7. "*Pemba Rice, Valley var.* (*Kibawa*)."—This consisted of rice in the husk, which was of straw colour and partially enveloped by two glumes. The grains were thin and of medium length. The sample was in good condition on the whole, but showed some signs of insect attack.

The rice when husked and cleaned yielded moderately hard, fairly clean, translucent grains. About 2 per cent. of the grains had a red cuticle, which could be removed by cleaning, yielding chiefly translucent grains. The length of the husked grains was about 6 mm., and the width 2 mm.

No. 8. "*Pemba Rice, Valley var.* (*Mzuri Wendo*)."—This consisted of rice in the husk, which was of a brown colour. The grains were medium to long, and of medium

width. The sample was free from extraneous matter, but it was slightly mouldy and showed signs of insect attack.

The rice when husked and cleaned yielded moderately hard, clear, translucent grains of good appearance. The length of the husked grains was from 6 to 7 mm., and the width averaged 2·5 mm.

As already mentioned, there is no market in the United Kingdom for rice in the husk, so that valuations of these samples, which were all in the husk, could not be obtained. Small quantities of sample No. 2, which may be regarded as fairly typical of the rest, were therefore husked at the Imperial Institute, and the husked grains submitted to two firms of merchants in London. One firm valued the sample at 10s. to 10s. *6d.* per cwt. ex ship London (April 1913) and suggested that a small trial consignment should be shipped to London at an early date.

The second firm stated that the husked rice was suitable for the United Kingdom market and would realise about 10s. per cwt. delivered in bags in London (April 1913).

East Africa Protectorate.—Rice is grown by natives in all suitable places along the coast-belt of the East Africa Protectorate. Slight depressions in the land are usually taken advantage of in which to form the rice patch, as such situations retain rain water. In the Vanga district rice is grown on a considerable scale, the necessary water for irrigation purposes being obtained from the river Umba.

British West Africa.—On the west coast of tropical Africa rice is grown by native cultivators wherever conditions are suitable, but the local output has to be considerably augmented by imports in order to supply the demand. In Sierra Leone rice is the most important food crop, both swamp and upland varieties being grown. Most of the varieties are, however, of a red colour, and in consequence are of little value on the European market; but a certain quantity is exported to other West African countries, about 29,000 bushels of unhusked rice being exported to French Guinea in 1912.

Experiments with varieties of rice from South India, as well as with local varieties, have been commenced at the newly established Experiment Station at Jala.

Experiments are also being conducted at the Experimental Stations in the Gold Coast with a view to obtaining a variety suitable for local cultivation.

In Northern Nigeria the cultivation of rice is said to be extensively carried on in the low-lying districts to the south of Sokoto, where large areas of swampy land exist. It is possible to develop the cultivation of this crop in the valleys of all the large rivers. As large quantities of rice are annually imported at the Southern Nigerian ports, a ready market might be found for the crop.

THE PRESERVATION OF HIDES AND SKINS FOR EXPORT

THE hides and skins obtained from animals slaughtered in the United Kingdom are not sufficient in quantity to meet completely the requirements of the home market, and large numbers are imported. The following table gives the quantities and values of the hides imported into the United Kingdom during the years 1910, 1911, and 1912:

Source.	1910.		1911.		1912.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
British Possessions.	*cwts.*	£	*cwts.*	£	*cwts.*	£
Australia	110,341	356,702	96,169	304,614	160,905	544,095
British India	129,871	420,529	98,374	323,023	148,212	482,979
Cape of Good Hope	32,945	127,857	42,346	161,365	77,990	325,145
Natal	80,809	278,989	75,078	250,051	91,878	325,082
Straits Settlements	40,450	109,961	33,147	90,282	48,154	137,138
Other British Possessions	70,384	231,580	59,789	200,004	86,092	311,157
Total from British Possessions	464,800	1,525,618	404,903	1,329,339	613,231	2,125,596
Foreign countries.						
Argentine	123,807	447,993	187,020	684,564	211,844	833,997
Russia	89,379	284,762	64,758	228,400	223,257	758,782
Italy	130,700	478,233	76,544	287,433	105,428	399,006
France	61,792	223,504	71,656	229,870	93,569	317,905
Germany	85,139	251,506	48,260	148,250	60,974	191,587
Netherlands	47,974	151,120	37,131	112,917	43,671	147,506
Belgium	31,234	91,016	27,753	80,914	36,742	117,235
Other foreign countries	246,226	819,080	202,374	644,756	227,893	762,088
Total from foreign countries	816,251	2,747,214	715,496	2,417,104	1,003,378	3,528,106
Total from all sources	1,281,051	4,272,832	1,120,399	3,746,443	1,616,609	5,653,702

Such imported hides frequently have to wait some time, in many cases weeks or even months, between being flayed and being used by the tanner, and it follows that if they are to reach their destination in good condition and in such a state as to meet the requirements of the purchaser, they must be submitted to some process which will preserve them efficiently against putrefaction and attack by insects.

There are a number of methods in use for the preservation of hides, but many of these are unsatisfactory, the hide itself being sometimes damaged by the careless treatment it receives. Such dissatisfaction was felt with many of the methods in use for curing hides and skins that in 1908, at their Brussels Conference, the International Association of Leather Trades Chemists appointed an International Commission to investigate these methods and make recommendations for their improvement. The method which the Commission decided was most satisfactory is that known as the "wet-salted method." The skin while being flayed should be prevented from coming in contact with dirt or blood and should be allowed to fall into a basket or other receptacle, where it is left to cool. It is then washed thoroughly and afterwards drained to remove the excess of water. The skin should then be laid out flat on a clean floor or a suitable low table, flesh-side uppermost, care being taken that every part of the flesh-side is exposed. Salt is spread evenly over the whole area of the flesh-side and another hide, similarly treated, placed on top, and the process repeated until a pile about 4 ft. high has been raised. Each skin should be given a quantity of salt equal to 25 per cent. of its weight, and it should be seen that the top skin is well covered over. Where large numbers of hides are being treated, the piles may be built differently, but in whatever way it is done the hides should have plenty of salt. The skins are left in these piles until all the salt has been absorbed, which generally takes about a week, and should they not be "salt-firm," that is, free from excessive moisture, at the end of this period they are again salted. As soon as the skins are salt-firm they may be baled for transport.

In the case of wool skins, particular care should be taken

to prevent moisture coming in contact with the wool during the flaying process. In this case the salting is performed by laying the skins out flat after cooling and rubbing the salt into the flesh-side, then folding the skins from belly to belly and baling them for shipment in this state.

The salt used should be fresh, clean, common salt, free from material deleterious to the raw hide or likely to cause trouble in subsequent treatment, while in no case should old or previously used salt be employed. Anhydrous sodium sulphate may be substituted for the common salt and applied in half the quantity, that is, at the rate of 10 to 15 per cent. of the green weight of the skins. In countries where there is a Government royalty or tax on salt, this commodity is denatured before it is put to any industrial use, in order to avoid the payment of this impost. Many materials have from time to time been employed for denaturing salt, *e.g.*, alum, soda, tar products, petroleum, etc., but all have been a source of difficulty to the tanner, as they form undesirable combinations with the hide substance or cause stains. Recently elaborate experiments on a large and practical scale have been undertaken at the Royal Tanning School at Turin, at the instigation of the Italian Government, to discover a suitable denaturant. These trials showed that, provided the salt was pure, the addition of 10 per cent. of borax and 1 per cent. of naphthalene was successful, as was also the addition of 1 per cent. of naphthalene, 10 per cent. of sodium sulphate, and 0·017 per cent. of bichromate of potash. The value of the latter mixture for curing could be improved by the addition of 5 per cent. of borax.

Under certain circumstances, when it is desired to economise weight, and therefore cost of transport, it is more convenient to ship the hides in the dry state, and, should this be the case, they should be "dry-salted" if possible. The skins, after flaying, should be well washed, as in the previous method, and should then be hung up in a cool room or shed until partially dry. In this state they are spread on the floor and salted in piles, after which they are re-hung until they have acquired a soft but elastic condition, when they are re-salted. This method should

only be followed if it is not possible to keep the skins in the wet-salted state, since dry-salted skins are much more difficult to wash and soften for tanning. Probably, also, the crystallisation of the salt has a weakening effect on the fibre of the hide.

In some countries, where salt is dear, the distance of land transit great, and the means of transport primitive, it is only practicable to dry the hides, without salting them. In this case they should be well washed free from blood and dirt, and in the final washing some aromatic material, such as naphthalene, tobacco juice, or some similar product obtainable locally, should be added to the bath. The skins should then be hung up by the hind flanks or over poles, with the flesh-side outwards, in the shade, with a current of air circulating freely round each hide, and on no account should drying be done on the ground or in the sun. This drying ought to take place evenly and gradually, yet rapidly. If it is carried out too slowly, putrefaction sets in; while, if too rapidly, the hide cakes on the outside, and the inside is left moist and putrescible, and there is a strong probability that, in some parts, the fibrous structure will be destroyed and "blistering" will result. The sheds used for drying should be so constructed as to prevent the ingress of flies.

During the washing the skins may be treated with arsenic as a preventive of insect attack. Hides cured by this method, sometimes known as "flint hides," are always more difficult to soften than those preserved by the other methods described, and they command a lower price in the market.

Of the methods described, that in which the hides are wet-salted should always be employed when possible, as hides thus treated command a higher price than those cured by either of the other two processes. It is this method that is carried out on a large scale in the Chicago stock-yards for "packer" hides.

It is remarkable that, in view of the high prices which hides realise, more attention is not given to ensuring their arrival on the market in the best condition. It is generally true that the increase in the value of the hides will easily repay any extra care that may be taken in their curing,

provided that they have been flayed properly to begin with, and are not disfigured by prominent "brands," tears, or other marks.

UTILISATION OF CERIUM EARTH METALS AND THEIR COMPOUNDS

RECENT developments in the technical use of the cerium metals for the manufacture of spark-emitting alloys furnish an example of the conversion of a hitherto practically useless product into a substance of considerable commercial utility.

The invention by Welsbach, in 1884, of the incandescent mantle for gas lighting led to a search for minerals containing thoria (see this BULLETIN, 1905, **3**, 151 and 285), as this oxide is the principal constituent of these mantles. This resulted in the discovery of large deposits of monazite, the mineral now chiefly used as a commercial source of thoria, which it contains to the extent of about 5 per cent. Monazite also contains about 65 per cent. of rare earth oxides other than thoria, which may for convenience be called the cerium earth oxides, since ceria is the chief component, and which have been practically of no value up to the present. These oxides consist of about 45 per cent. cerium sesquioxide, 25 per cent. lanthanum oxide, 15 per cent. neodymium oxide, 7 per cent. praseodymium oxide, the rest being oxides of yttrium, samarium, etc. There have been accumulated at the various thoria works many thousands of tons of these hitherto unutilised cerium earth oxides.

In 1903, Welsbach found that the alloy, or mixture of metals, produced by the reduction of these cerium earth oxides, had pyrophoric properties, *i.e.* when struck or rubbed it had the property of emitting sparks. The production and use of such alloys he patented (German patent 154,807 of 1903; British patent 16,853 of 1903). At a later date it was found that the pyrophoric property of this mixture of metals was due to the presence of a superficial coating of oxides, which needed frequent renewal in order that the spark-emitting property should remain

unimpaired, and various patents were granted for methods of producing this active layer, such as heating the mixture of metals in a limited quantity of air. The necessity for such renewals was, however, disposed of by the discovery that alloys of this mixture of cerium earth metals with certain other metals, such as iron, nickel, cobalt, or manganese, possessed permanent pyrophoric properties. Thus, experiments showed that alloys containing from 10 to 65 per cent. of iron had these properties, but that the best proportions were 35 per cent. of iron with 65 per cent. of the mixed cerium earth metals, and at the present time many of the automatic lighters on the market contain spark-emitting material of this composition. Alloys of this type are now being made in Germany, the United Kingdom and Austria, the cerium earth metals being obtained by electrolysis of the anhydrous cerium earth chlorides. Many difficulties have been experienced in working this process owing to the fact that the mixture of cerium earth metals reacts easily with oxygen, nitrogen, hydrogen, and also other gases, such as carbon monoxide or dioxide, so that it has proved difficult to find a gas suitable for the production of an artificial inert atmosphere in which the operation of reducing these oxides to the metallic state can be conducted efficiently.

This alloy of iron with the cerium earth metals, which is often sold under the name of "Auer" metal, is hard and quite permanent in air.

Another pyrophoric alloy, patented about 1909, and known as "Kunheim" metal, consists of a mixture of hydrides of the cerium earth metals with magnesium and aluminium, and is produced by first alloying the cerium earth metals with magnesium and aluminium, then heating the alloy to a temperature of about 500° C. in an electrically heated muffle furnace in a current of dry hydrogen. By this means the cerium earth metals are converted into hydrides. The commercial product is stated to have the following composition:

	Per cent.		*Per cent.*
Cerium earth metals	85	Iron	0·5
Magnesium	10	Hydrogen	1·3
Aluminium	1·0	Silicon	0·5

It is interesting to note that whereas the hydrides of the individual cerium earth metals are unstable in air and lose hydrogen at a red heat, the mixture of hydrides is quite permanent in air, and at a fairly high temperature. "Kunheim" metal is lighter than the "Auer" metal, and is stated to be cheaper to produce.

A pyrophoric alloy, patented recently, consists of an alloy of manganese and antimony containing 5 per cent. of cerium earth metals. It is stated to be as efficient as those described above, and to cost much less to produce.

This new industry is said to be making rapid progress; in 1911 the output of "Auer" metal was given as about 10 tons, and, according to a recent statement, about 200 tons of the cerium earth oxides are now consumed annually for these purposes.

The general method of utilising these alloys as spark emitters is to cause a rotating piece of hard steel having a roughened edge to strike the alloy by means of a simple mechanism set in motion by pressure with the fingers, and so cause it to emit a shower of sparks, which ignite petrol or some other inflammable material on a piece of cotton wick. One kilogram (2¼ lb.) of the alloy is sufficient to make between 3,000 and 4,000 automatic lighters, and each of these is capable of giving from 2,000 to 6,000 separate ignitions. The introduction of these automatic lighters must have had a considerable effect on the match industry, and in such countries as France, where the manufacture of matches is a state monopoly, a tax has been imposed on these alloys, and on automatic lighters.

Numerous alloys of cerium with other metals have been described, but none of these are of technical importance at present. Cerium-mercury alloys are spontaneously inflammable in air, whilst cerium-magnesium alloys containing about 25 per cent. of the latter element can be readily powdered. Cerium earth metals are extremely reactive, reducing many metallic oxides with the evolution of much heat, and have been employed for the reduction of certain refractory oxides, such as those of niobium, tantalum, molybdenum, and zirconium.

Fluorides of the cerium earths are sometimes used,

together with calcium fluoride, as a constituent of "carbons" for electric flame-arc lamps. The effect of this mixture, which in some cases constitutes 70 per cent. of the whole carbon, is to increase the whiteness of the light. According to a recent statement (*Zeits. angew. Chem.* 1913, **26**, 806), about 300 tons per annum of the cerium earth oxides are used for this purpose. Cerium carbide has also been used to a small extent as a filament in incandescent electric lamps.

Many uses have been suggested for the cerium earths and their salts, *e.g.* in electrical accumulators, as a "contact" substance in the manufacture of sulphuric acid, and for photographic purposes. In medicine the cerium earth oxalates have been used to avoid or minimise nausea. Didymium salicylate has been used under the name of "dymal" as an antiseptic, non-irritant dressing for wounds.

In porcelain manufacture salts of neodymium are sometimes employed to give an amethyst-red colour, and praseodymium compounds to give a bright green. When about 1 per cent. of cerium oxide is added to potash glass a clear yellow colour is produced, which becomes brown when large quantities of ceria are used. "Didymium glass" has a fine blue colour, and is used for the production of coloured optical glasses.

Solutions of didymium salts are also used for branding trade names on incandescent gas mantles.

Numerous attempts have been made to utilise the cerium earth salts in the textile industry. According to one recent patent, yarn is treated with a solution of cerous chloride, having a specific gravity of 1·16 to 1·26; it is then dried, and passed through a strongly alkaline bath of sodium hypochlorite. After again drying it is woven with untreated yarn. If such cloth is dyed with a direct cotton dye, and then submitted to an acid bath, the yarn previously treated with the cerium compound loses its colour, thus producing a variegated pattern. With certain other dyes the reverse change occurs. Cerium salts have also been employed to some extent as mordants in leather dyeing.

GENERAL NOTES

Imperial Institute Handbooks to the Commercial Resources of the Tropics (Vol. iii., Rubber).—The third volume of this series of Handbooks, entitled *Rubber: Its Sources, Cultivation, and Preparation*, by Harold Brown, Technical Superintendent in the Scientific and Technical Department of the Imperial Institute, was published in February.

The aim of the book is to give, so far as is possible within the limits of 250 octavo pages, a general account of the subject of rubber production, including descriptions of the principal rubber-yielding plants and their exploitation in the wild or cultivated states. In accordance with the scheme of this series of Handbooks, considerable attention is given throughout to the rubber industry in British West Africa.

The first portion of the book is mainly devoted to a consideration of the general questions connected with the subject, such as the characters and composition of latex and rubber; the principles of tapping and the systems commonly adopted; the methods of preparing rubber; the chemistry of rubber; and statistics of production, consumption, and prices.

The principal rubber-yielding plants are then dealt with in some detail, separate chapters being given to the Para rubber tree (*Hevea brasiliensis*); the Ceara rubber tree (*Manihot Glaziovii*) and other species of Manihot; the African rubber tree (*Funtumia elastica*); the African rubber vines (*Landolphia* spp., etc.); the Central American rubber tree (*Castilloa elastica*); and the Assam rubber tree (*Ficus elastica*) and other species of Ficus. The rubber plants which are of less commercial importance than the foregoing are treated together in a general summary.

The book, which is illustrated by photographs, is published by Mr. John Murray, Albemarle Street, W., price 6*s.* net.

New Series of Selected Reports from the Imperial Institute.—In 1903 a volume of *Technical Reports and Scientific Papers*, containing the principal reports made by the Scientific and Technical Department of the Imperial Institute up to that date, was published. The reports made since then are now being published in the *Miscellaneous Series of Colonial Reports*. Parts I. and II., dealing respectively with Fibres, and Gums and Resins, were published in 1909 [Cd. 4588] and [Cd. 4971]; Part III., Food Stuffs, in 1910 [Cd. 5137]; and Part IV., Rubber and Gutta Percha, in 1912 [Cd. 6022]. Part V., dealing with Oil-seeds, Oils, Fats, and Waxes, has just been issued [Cd. 7260], price 8½*d.* The material dealt with in this part comprises both vegetable and animal products; the former are arranged under the headings, drying,

semi-drying, and non-drying oils, solid or semi-solid oils (fats), and waxes; the products of animal origin include fish oils and beeswax. In addition to well-known oils such as palm oil, ground nut oil, and castor oil, etc., a very large number of new or little-known oils suitable for the manufacture of paint, soap, or edible products, etc., are dealt with. In most cases where the seeds have been examined an account is also given of the feeding and manurial qualities of the cake or meal left after the extraction of the oil.

Agriculture in the Gold Coast.—The *Government Report on the Agric. Dept., Gold Coast*, 1912, contains an account of agricultural development during the year, together with reports on the separate agricultural stations and some notes by the Government Entomologist on various insect pests, principally those attacking cocoa, cola, and coconut trees. The cultivation of cocoa is still being extended. Considerable areas will probably soon be established with the "Cundeamor" variety (see this BULLETIN, 1912, **10**, 556), but the cultivation of this variety to the exclusion of "Amelonado," at present grown, is not recommended, as the latter is regarded as better suited to local conditions. Although a decrease of 2½ million pounds is shown in the exports of cocoa for 1912, as compared with those of 1911, the value was about £30,000 more, owing to higher prices ruling in Europe. The deficit in quantity is stated to be due principally to later ripening, as the harvest season extended into January; and the anticipation that an unusually large proportion of the crop will appear in the returns for 1913 has been realised, as, according to a cable received at the Colonial Office from the Gold Coast, the cocoa crop in 1913 amounted to the record quantity of 113,239,980 lb., valued at £2,484,218.

Exports of cotton amounted to 20,400 lb., valued at £500, but although this is fully double the amount exported in 1911, it is stated that cotton as a single cultivation cannot be profitable, and the native method of planting cotton in admixture with other crops is recommended. An account is given of experiments carried out at the Tamale station with varieties of cotton. Sisal and Mauritius hemps are also growing fairly well at this station. The quantity of cola nuts exported was the largest on record, being valued at £134,231. Very large quantities were taken into the interior, and are not included in the above figures. Exports of copra show a decrease of 150 tons, although the quantity is above the average. Exports of palm oil show a considerable decrease, although the quantity of palm kernels exported was the largest since 1902. The exports of rubber for 1912 show a very large decline, but native farmers are stated to be paying more attention to the planting of rubber trees on their cocoa farms, and Para

rubber seeds and seedlings are in great demand. Experiments have been carried on throughout the year at the Agricultural Stations on the tapping, etc., of different varieties of rubber trees, and on the cultivation of various crops, including coffee, ground nuts, foodstuffs, ginger, and tobacco.

The Agricultural Department of the Northern Territory of Australia.—The Northern Territory of Australia, which had previously been part of South Australia, was taken over by the Commonwealth Government on January 1, 1911, and on January 1 of the following year a Department of Agriculture was inaugurated. An account of the work of this department is included in the *Report* of the Administrator of the Territory for 1912, which was published last autumn. It is preceded by a historical account of agricultural industry in the Territory, from the time the first settlement was made on Melville Island, in 1825, to the present. Though the suitability of the land for certain crops was often demonstrated, very little was accomplished in pure agriculture; stock raising, however, made great progress until checked by the outbreak of redwater or tick fever in the eighties.

In 1911, sites for the establishment of demonstration farms were selected, and work on these has been commenced. The most advanced of these is at Batchelor on the railway about 60 miles from Port Darwin. It has a frontage on the railway of a little over a mile, and extends eastwards for 4 miles. It includes a variety of soils typical of the country, namely open forest land, a rich black soil which is swampy in the wet season, and stony ridges and hills affording dry stock-runs in the wet season. In the first year a great deal of preliminary work had to be accomplished, clearing the land, removing trees and their roots, fencing, and preparing the land for crops; and the necessary buildings had to be erected. Precise statements as to the cost of these operations are given for the guidance of future settlers. The main object of the farm is to demonstrate methods of stock raising and fattening with the aid of improved pastures and of fodder crops, so special attention was directed to the growth of the latter, and lucerne, sorghum, and cowpeas were found to do well.

The draught horses in the Territory are of very poor quality, so a Clydesdale stallion and 18 Clydesdale mares were imported from Victoria, in order to introduce a better type. Horses suffer much from the attacks of flies, so a large fly-proof stable is to be erected to protect them when not at work. Various dressings have been tried to repel the flies, and an emulsion of castor oil and washing soda has proved of some value and is coming into general use. Dairy cattle, sheep, pigs, and poultry have been imported.

The other demonstration farm is on the Daly River, and

is not so readily accessible, but by April 1913 a good start had been made. On this farm attention will be specially devoted to dairy farming and the crops it requires, and also to the growing of tobacco, sugar-cane, cotton, or other crops requiring intensive cultivation, since there are facilities for irrigation in the Daly District.

Government Inspection of Wattle Bark in South Africa.—The Government of the Union of South Africa have decided to undertake, from and after April 1, 1914, and until further notice, the inspection of wattle bark prior to its shipment from South Africa, and a Government notice embodying the conditions under which the inspection will be carried out has been issued (No. 2,032, December 23, 1913). A summary of these conditions is given below :

Each exporter who desires to have his bark inspected must previously complete an agreement with the Department of Agriculture, which will register his trade mark. All bark to be inspected must be packed in bags, each containing not more than 200 lb. gross weight. The official grades are as follows: H. 1, Heavy (first class); H. 2, Heavy (second class); M. 1, Medium (first class); M. 2, Medium (second class); T. 1, Thin (first class); T. 2, Thin (second class); B. G., Below Grade. Standards for the different classes of bark will be fixed by the Government, and the grading will be made in accordance with such standards. Every bag of bark submitted for inspection must contain on the sewn end the coat of arms of the Union of South Africa, followed by the grade mark, whilst the trade mark of the exporter must also be placed on the bag. Not less than 10 per cent. of a consignment will be examined by the inspector before a certificate is granted, and if any portion of the number of bags examined by him is found to be wrongly graded, he will grade it correctly and indicate the fact that it was found necessary to alter the grading on the certificate. For each bag of bark inspected, a charge of a halfpenny will be made to the exporter. Any exporter or his agent who is dissatisfied with any decision of the inspector as to the grading of the bark, may appeal to the appointed referee, whose decision shall be final.

It is hoped that the inauguration of this system of inspection will be in the best interests of the industry, and will prove to be of assistance not only to the shippers, but also to the European merchants dealing in wattle bark.

Cotton Seed Distribution in Egypt.—The Department of Agriculture in Egypt has realised that one of the best means of improving the cotton crop is the selection and distribution of good seed for sowing, and it has therefore devised a plan for carrying this into operation. The system consists of (1) the ordinary distribution scheme, under which good "Taqâwi" (*i.e.* seed for sowing as dis-

tinguished from "Tugari" or commercial cotton seed) is supplied to the small cultivators, and (2) the States Domains scheme, under which selected "Taqâwi" grown on the States Domains is supplied to the largest and most careful cultivators. A full account of both schemes has been published in the *Agricultural Journal of Egypt* (1913, **3**, 1).

In initiating the ordinary distribution scheme, it was necessary to bear in mind that the fellahîn, or native cultivators, are extremely improvident, and will purchase inferior seed on account of its cheapness, and that being in many instances in a needy state, they were compelled in the past to obtain their seed under the onerous conditions imposed by unscrupulous dealers. The Department therefore decided to supply the fellahîn with better seed than they had been obtaining hitherto, and at a more reasonable price and under less burdensome conditions. The seed is distributed on credit, and its cost is collected subsequently with an instalment of the land tax. It was also decided to restrict the distribution on credit to the fellahîn planting 8 acres or less, this being the predominating class of cultivators and the one most in need of the advantages afforded.

The scheme was started in 1910–11, when 1,570 ardebs (1 ardeb = 5·445 bushels) of seed were distributed in the Sharqîa Province. In 1911–12 the distribution was extended to the whole of Egypt, and the quantity of seed issued on credit amounted to 39,190 ardebs. During 1912–13 no less than 76,527 ardebs were distributed on credit to the peasant farmers. Nearly every village in Upper and Lower Egypt has been visited by special sub-inspectors, and the system of distribution explained. Applications for seed were received in 1912–13 from more than half the villages in the country. The seed supply is obtained from first-class ginners, who realise the importance of the project and the responsibility they incur, and consists of good Taqâwi (*a*) which the ginners provide from crops they have purchased, and (*b*) which comes from crops which have been inspected in the fields and are recommended by the Department's inspectors. Special arrangements have been made for bagging the seed and for inspecting the seed in the ginneries.

By means of the scheme outlined above, the Department of Agriculture is able to distribute much better seed than the growers could obtain otherwise. There is not at present, however, any highly selected seed available for extensive distribution, and steps are therefore being taken to introduce a pure type of seed in sufficient quantity to replace the deteriorated and mixed varieties now grown. This work is being carried out on the Department's experiment farms, but a considerable time must necessarily elapse before the results will be of practical utility to

the general distribution scheme. Meanwhile it has been decided that the States Domains seed should be adopted as a basis, this seed being recognised as the best obtainable in the country because of the great care which the States Domains Administration devotes to the cultivation and ginning of the crops. Arrangements have been made for a certain quantity of the seed produced on these estates to be placed each year at the disposal of the Department. This seed is distributed to the larger cultivators on condition that 50 per cent. of the seed resulting from its growth should be available for the use of the Department. This resultant seed is then sold to medium cultivators on the same condition, and the seed obtained from them enters into the ordinary distribution scheme for the smaller cultivators. To avoid confusion, the original seed from the States Domains is termed "Domains Taqâwi," the seed resulting therefrom (*i.e.* the second generation) "Domains Seed," whilst the seed resulting from the latter (*i.e.* the third generation) is known as "Domains Seed Fellâhi." By this means it is hoped that a well-organised scheme, to which all the cultivators will have become accustomed, will be in good working order by the time that the pure seed types which are being bred on the experiment farms by Mendelian methods become available for distribution. It is anticipated that in the course of two or three years there will be a sufficient supply of such seed to replace the Domains seed at present employed in the distribution scheme.

Caracul Sheep Breeding in German African Colonies.—The caracul sheep is of economic interest chiefly on account of the young lambs, which furnish the caracul or Persian lamb skins, which are valued highly for their curly black fur. These sheep are natives of Bokhara and neighbouring parts of South-western Asia, and are apparently of the same breed as the Astrachan sheep. The exact breed of sheep seems to be a matter of some uncertainty, as the published information refers loosely to caracul, Persian, or Astrachan sheep, without giving definite particulars which would enable distinctions to be made. According to the British consul at Bushire, Persia (*Natal Agric. Journ.*, 1908, **11**, 269), two distinct breeds are recognised in South Persia and Arabia, viz. the "Arabi" and the "Turki" or "Suri" breeds. The Arabi sheep are particularly hardy, are of heavier build, and yield better wool than the Turki sheep.

Prof. Wallace has stated (*Estate Magazine*, 1912, Nov., p. 657) that the breeding of caracul sheep has been taken up in many countries outside Persia; California, Eastern Russia, Germany, and German South West Africa being mentioned: and attention has been drawn by him to the possibility of establishing this breed in the United Kingdom.

Persian sheep have also been introduced successfully into Natal and other parts of the Union of South Africa, where they have been found valuable on account of their hardiness and capability of withstanding heat and drought. As far as can be ascertained little or no attention has been paid to the production of valuable lamb skins in the Union of South Africa, the sheep being used there as a source of wool and mutton.

An article has appeared recently (*Tropenpflanzer*, 1913, **17**, 593) giving some information about the breeding of caracul sheep in Germany and in German South West Africa, and also discussing the suitability of the breed for German East Africa.

Caracul sheep were first introduced into Germany in 1903, as being suitable for tracts of the poorest, sandy types of soil. Experiments have shown that both the pure-bred caracul sheep and crosses with several European breeds yield valuable lamb skins, and caracul sheep breeding is stated to have been taken up in several localities, although no information is given as to whether any appreciable number of skins have been obtained.

In German South West Africa, the first consignment of caracul sheep was received via Vienna in 1907. A second consignment, consisting of 251 ewes and 23 rams, obtained direct from Persia, reached Swakopmund early in 1909. These sheep have been used for the establishment of flocks, some being kept for experimental purposes at the Government farm at Windhuk, and the remainder supplied to farmers for breeding purposes. As it is almost impossible to obtain pure-bred caracul sheep in any large numbers, the pure-bred sheep have been crossed with the indigenous African fat-tailed sheep with satisfactory results. In April 1912 there were over 4,000 sheep in this colony, of which 341 were pure-bred caracul sheep, the remainder being half-bred. Skins of the half-bred lambs were valued at 4*s*. to 8*s*. each in Leipzig, but it is expected that much improvement will result from further breeding. The number of skins produced so far is not stated.

The method of establishing a flock is to pair a pure-bred caracul ram with thirty to fifty African fat-tailed ewes during October and November; the lambs are born in March and April, at the end of the rainy season, when the ewes have plenty of water and pasturage. The ram may be used for further breeding in March if strong and well-fed. The best of the male lambs may be killed for the sake of the skins, while the other males are used for fattening. The ewe lambs are kept and used when one and a half years old, at the earliest, for breeding; inbreeding being avoided by the introduction of new rams.

For the production of skins the lambs are generally killed when only five or seven days old, but are sometimes

kept for some weeks in Persia, being provided with leather coverings to prevent the wool from uncurling and becoming dirty. Great care is necessary in the preparation of the pelt: the skin, after being cleanly flayed, is carefully stretched out and dried in the shade; salting is not recommended, but naphthalene may be used as a preservative. The flesh of the flayed lambs may be used as food, while the ewes' milk may also be turned to account for cheese making.

In German East Africa certain high-lying tracts of land, *e.g.* those between Kilimandjaro and Lake Nyasa, are considered promising for caracul sheep, but no industry appears to have been established there yet.

Under suitable conditions the breeding of caracul sheep appears to be profitable, as the sheep are hardy, and cross readily with other breeds. The lamb skins vary very much in value according to quality; a firm in Leipzig dealt with 385,000 skins in one year, the average price being about 16s. each; fine-quality skins may fetch 60s., and even more than this is paid for fancy qualities. The introduction of this breed of sheep into British colonies where climatic conditions are favourable is worth careful consideration.

Mining Law in Nigeria.—The Governor of Northern Nigeria recently issued a Minerals Proclamation, entitled *A Proclamation to regulate the right to search for minerals and also to dig for, mine and work minerals, and also for other purposes relating thereto.* It is dated November 26, 1913, and came into operation on December 2, 1913.

According to this proclamation, a prospecting right entitles the holder to prospect for one year in those parts of the Protectorate which are not included in any mining lease or exclusive prospecting licence, and which the Governor has not by notice in the *Gazette* declared to be closed to prospectors or reserved from prospecting. The fee to be paid for this prospecting right is £5. The applicant for a prospecting right must, if required by the Governor to do so, show that he possesses sufficient money or credit to enable him to carry on his work, and a credit of £100 with a local bank will usually be required for this purpose.

An exclusive prospecting licence entitles the holder to the sole right of prospecting for minerals within an area not less than one square mile, and not more than sixteen square miles in extent, and for a period of one year, subject to renewal, at the discretion of the Governor, for further terms of one year each up to three years; provided that the area or any part of the area, formerly subject to an exclusive prospecting licence which has lapsed, shall not be the subject of the issue of another exclusive prospecting licence. Under certain conditions the Governor may grant a renewal for a fourth year. The rent to be paid for an

exclusive prospecting licence is £5 per square mile per annum for any period up to three years, and £12 10*s.* if renewed for a fourth year.

The preliminary fee for the survey of an area held under an exclusive prospecting licence is £15 per area, provided that where two or more areas are in close proximity the fee may be reduced at the discretion of the Director of Surveys. In addition to this, the fee for the survey of a boundary is from £3 3*s.* to £5 5*s.* per mile or part thereof, according to the character of the country surveyed.

An applicant for a mining lease must hold a prospecting right or an exclusive prospecting licence, and no lease can be transferred without the consent of the Governor. A mining lease may be granted for any term not exceeding twenty-one years, and if the work is satisfactory the lessee will be entitled to renew the lease for a further term not exceeding twenty-one years. Mining leases are classified as (*a*) lode mining, (*b*) alluvial mining, (*c*) stream mining, (*d*) iron mining, (*e*) carbonaceous minerals, (*f*) earthy minerals, (*g*) water power, and (*h*) dredging leases.

The royalties to be paid by holders of mining leases may be collected in the form of an export duty. The royalties fixed up to the present are: For tin ores and metallic tin, 5 per cent. of the value until the railway has been declared open to Naraguta, and after that 7½ per cent.; on lead ores or metallic lead, containing on an average less than 4 oz. of silver per ton, 2 per cent. of the value, and if containing more than 4 oz. of silver per ton, an additional 3 per cent. on the value of the silver; on iron ores or metallic iron, 1 per cent. of the value.

Many other matters of importance to prospectors and mine owners are dealt with in the proclamation. One noteworthy clause compels every employer of native labour in connection with mining or prospecting operations to pay each labourer personally and individually in cash monthly (or at shorter intervals) the total amount of the wages due to him without deduction. The payment is to be made in the presence of a responsible officer and certified by him. If an employer has recruited labourers from a distance he must either repatriate them by train or otherwise or provide them with reasonable maintenance and transport allowance for the journey to their homes.

Another document that has been issued recently with reference to the mining industry of Nigeria is the *Minerals (Amendment) Ordinance*, Southern Nigeria, dated December 3, 1913, and published in the *Southern Nigeria Government Gazette* for December 17, 1913.

Mineral Production of India.—In his annual report on the mineral production of India during 1912 (*Rec. Geol. Surv. India*, vol. 43, part 2, 1913), the Director of the Geological Survey reports a considerable increase in the mineral

output. The value of the total output for 1912 was £9,321,486, which exceeds that for any preceding year, and is over a million and a quarter sterling in excess of that for 1911, an increase of nearly 17 per cent. The chief items of the output value for 1912 are shown in the following table:

	£	Percentage variation on output for 1911.
Coal	3,310,365	+ 32·3
Gold	2,271,806	+ 1·5
Petroleum	975,278	+ 10·3
Manganese ore	884,404	+ 36·3
Salt	509,824	+ 8·6
Mica	284,290	+ 50·7
Building materials, etc.	270,980	+ 10·0
Saltpetre	217,035	− 1·5
Lead ore and lead	153,069	− 15·9
Tungsten ore	115,200	+ 15·2

Other items of considerable note are corundum (chiefly gem varieties), clay, iron ore, tin ore, monazite, copper ore, silver, and jadeite. The less important minerals include magnesite, chromite, alum, steatite, garnet, gypsum, bauxite, diamond, platinum, amber, ochre, and samarskite.

The large increase in the total value of the coal output was due partly to an increase in price. The tonnage increase was nearly 16 per cent. over that of the previous year, whereas the increase in total value was 32·3 per cent. As usual, the Gondwana coalfields contributed nearly the whole output, the amount mined in these fields being 14,298,083 tons, compared with 408,256 tons obtained in the Tertiary coalfields.

Both in Orissa and Singbhum there was a considerably increased output of iron ore, and the rise in value of the output, from less than £10,000 in 1910 to nearly £50,000 in 1912, is attributed to the activity of the Tata and Bengal iron and steel companies.

A drop in the value of the jadeite output, from £41,660 in 1911 to £10,800 in 1912, is attributed to the disturbed condition of China and consequent restriction of trade, China being the chief purchaser of Burmese jadeite.

A notable feature, that is rather out of harmony with the general progress of Indian mining during 1912, was the discontinuance of graphite mining. Graphite had been mined for some time in Travancore, and the output, which had a value of over £20,000 in 1910, dropped to £9,425 in 1911, and ceased altogether in 1912.

Reference has already been made in this BULLETIN (1913, **11**, 609, 702) to the increased output of tungsten ore and monazite in Burma and Travancore respectively during 1912.

Mineral Production of New South Wales.—*The Annual Report of the Department of Mines, New South Wales, for the year*

1912 puts the total value of the mineral production for that year at £11,641,435. This is an increase of £1,883,428 on that for the previous year, and a record output for the State, being £1,064,057 in excess of that for 1907, which was the previous best year. This result is attributed to highly favourable prices for metals, the absence of serious labour disputes, and a marked expansion in the coal trade. The chief items are as follows:

	£	Variation from previous year. £
Coal	3,660,015	+ 492,850
Silver and silver-lead, etc.	3,745,796	+ 1,093,248
Zinc	1,766,242	+ 351,262
Gold	702,129	− 67,224
Copper	579,791	− 10,311
Portland cement	368,280	+ 52,711
Tin	338,074	+ 30,985
Lead	264,530	+ 54,746
Iron	130,708	− 14,708

Other items in the output include opal (£35,008), oil shale (£34,770), wolframite (£16,584), alunite (£13,700), scheelite (£4,963), platinum (£3,880), molybdenite (£3,706), diamonds (£2,001), bismuth ore (£1,210), and antimony ore (£355).

The output of silver-lead was the largest on record, chiefly from the Broken Hill mines. In this connection the considerable increase in zinc ore, which is exported in the form of concentrates, is also notable.

With reference to the diminished gold output, it is remarked that prospecting for this metal has been neglected owing to the remunerative employment offered by other branches of the mining industry.

Although the copper output decreased on the whole, there was an increased production at the mines in the Great Cobar District, and one of the features of the year was the re-opening of the Lloyd copper mine, which had been closed down since 1909 owing to the difficulty of obtaining fuel.

The greater portion of the tin output was, as usual, obtained by dredging. The tin-ore dredges recovered 1,626 tons of stream tin, valued at £223,813, which is £15,718 in excess of the previous year's production. The most successful results were secured by the dredges in the Emmaville Division, the output there being 744 tons, valued at £101,943.

There was a diminution in precious opal and diamonds. As in the previous year, the diamonds were obtained only from the Copeton district, where they are obtained from the alluvial workings, though pipe formations at Oakey and Staggy creeks were actively prospected.

Platinum mining was carried on throughout the year at Platina, in the Fifield Division. The deposits were worked to a depth of about 60 ft., and the proportion of the associated metals, so far as could be ascertained, varied from 4 to 8 parts of platinum to 1 of gold per load.

The value of the alunite output, which was obtained wholly from Bullahdelah, was £9,905 in excess of that for the previous year.

An Electrical Process for the Purification of Clay.—An interesting process, originally invented by Count Schwerin, which may prove to be of considerable technical importance in the treatment of low-grade clays, has been described recently by Dr. W. R. Ormandy (*Trans. English Ceramic Soc.* 1913, **12**, 36). In the process usually employed for preparing clay, the raw material is made into a thin "slip" with water, and the heavier and coarser impurities are allowed to settle out. This treatment is not always effective when the impurities are present in a finely divided state, and the new process is stated to be particularly suited for the purification of material of this character. The raw clay, as dug, is made into a "slip" with water, and to this is added a very small quantity of a suitable electrolyte. This addition causes the "slip" to deposit immediately the greater proportion of its solid impurities, but the clay remains in suspension and cannot be recovered either by allowing it to stand or by filtration. Most clays, when suspended in this manner, have strongly electro-negative properties, whilst the impurities, such as the oxides of iron and titanium, are mostly electro-positive, and the free silica behaves as a nearly neutral substance. Advantage is taken of these properties in the next stage of the process. After allowing the mixture of "slip" and electrolyte to stand for one to three hours, in order to allow the coarser particles of the impurities to settle out, it is next run through the "Osmose" machine. This latter may be briefly described as a semi-circular trough in the centre of which is a revolving metallic drum serving as the anode. Under this drum, and distant from it about half an inch, is the cathode, which consists of a wire screen. The clay "slip" passes between these electrodes and is subjected to a direct electric current of 60 to 100 volts. This treatment causes the clay substance to collect on the slowly revolving anode, and the impurities to attach themselves to the cathode, from which they are removed by means of a continuous worm. As the inner cylinder slowly revolves the clay substance comes away, at the top, in the form of a continuous blanket, 1·5 yd. wide, and about ¼ in. thick.

The clay, as it leaves the "Osmose" machine, contains from 18 to 30 per cent. of water, the amount depending largely upon the voltage of the electric current used: within certain limits, increase in voltage causing a decrease

in the amount of water retained by the clay. The improvement in the quality of the clay may be illustrated by selecting, from the numerous examples quoted in the paper, the case of a Dudley fire-clay. The "Osmose" treatment raised the melting point of the material from Seger cone 34 to 35, but lowered the sintering temperature by nearly 300° C. The purified clay, when burnt, was in point of colour equal to a good ball clay. The percentage of alumina, calculated on the ignited product, was raised from 39 to 44 per cent.

The effect of varying the time of settling is shown by the behaviour of a Hedwigsfreude clay, which, after standing for one hour, gave a final product containing 40·46 per cent of alumina (calculated on the ignited material). When allowed to stand for three hours this percentage was raised to 43·75, and fourteen hours' standing gave a product containing 45·57 per cent. Thus it is seen that the quantity of silica left in the final product can be adjusted to suit the potter's requirements.

Amongst the other advantages claimed for this process over the older methods, the following may be mentioned. In many cases the yield of purified clay is increased, the space occupied by the plant is considerably less, and the consumption of water is largely reduced.

The cost of the electric current necessary for the above treatment is stated to vary from 4*d.* to 2*s.* 6*d.* per ton of finished product, according to the nature of the clay. An average estimate, however, may be taken as 1*s.* 6*d.* per ton, if the electrical energy can be obtained at ½*d.* per unit. The plant necessary for producing 40 tons per day of clay, containing 30 per cent. of water, is stated to cost about £5,000.

RECENT PROGRESS IN AGRICULTURE AND THE DEVELOPMENT OF NATURAL RESOURCES

In this section of the BULLETIN *a summary is given of the contents of the more important papers and reports published during the preceding quarter, in so far as these relate to tropical agriculture and the utilisation of the natural resources of the Colonies, India, and the Tropics generally.*

AGRICULTURE

Soils.—In *Bulletin* No. 6, *U. S. Dept. Agric.* (The Agricultural Utilisation of Acid Lands by means of Acid-tolerant Crops), attention is called to the fact that one of the chief sources of acidity in soils is decaying vegetable matter, and it is shown that the acidity of one acre of alfalfa (estimated at 2·5 tons of dry material) requires 267 lb. of limestone for its neutralisation. Although crops

which require their nitrogen in the form of nitrates are not a success in acid soils, owing to the fact that nitrifying bacteria cannot thrive in acid media, there are certain crops which grow well in soils of this character, and which possibly obtain their nitrogen by other means. Amongst these are the whortleberry, cranberry, strawberry, blackberry, raspberry, potato, rye, oats, millet, sweet-potato, buckwheat, maize, carrot, and turnip. When a green manure is required for use on acid soils, use can be made of the cowpea, soy bean, or hairy vetch.

The saline nature of the soil water of the estates on the coast of British Guiana is stated to have caused considerable trouble in the cultivation of sugar-cane. Experiments have shown that the saline matter is absorbed by the plant during growth, with the result that the juice contains an excessive amount of mineral matter which forms compounds with the sucrose. M. Bird (*Journ. Indust. and Eng. Chem.* 1913, **5**, 1012) found that the soil waters contained a large amount of magnesium salts. As the lands are often below sea-level, these waters cannot be removed by drainage, and so the experiment was tried of dressing the land with slaked lime, at the rate of 2 to 3 tons per acre. It is stated that this treatment caused a marked improvement in the quality of the juice from sugar-cane subsequently grown on the land.

Foodstuffs and Fodders

Cocoa.—A useful note entitled "The Practice of Cacao Fermentation," by Arthur W. Knapp, has been reprinted from *Tropical Life*. The author visited a considerable number of plantations in Trinidad and Grenada, and, as a result of his observations on the methods adopted there, gives a number of suggestions for obtaining a good fermentation. An account is given of a method for fermenting small quantities of beans, and the results of an experiment are quoted which show that it is not the size of the fermenting box, but the amount of protection from cooling, which determines the temperature of the fermenting beans and their degree of fermentation.

Elephant Grass.—An account of this grass (*Pennisetum purpureum*) as a paper-making material was given in this Bulletin (1913, **11**, 68). New observations on the utility of the plant as a fodder are published in *Rhodesia Agric. Journ.* (1913, **10**, 833). It has been found to keep green throughout the winter months in Salisbury, and provides an excellent, succulent green fodder for cattle during that period. During the season 1912-13 an experimental plot was cut twice, yielding respectively 12 and 15 tons of green fodder per acre. Under poor conditions, such as dry situation, red or sandy soil, and a cold climate, elephant grass is regarded as being superior to sugar-cane as a fodder plant. Under

better conditions of soil and climate, the latter is likely to give equal or better results. In damp situations elephant grass wilts and is best replaced by Paspalum.

Sudan Grass.—*Circ.* No. 125, *Bur. Plant Indust., U. S. Dept. Agric.*, contains an account of this drought-resistant fodder plant. The seed was obtained from the Sudan in 1909, where the grass grows wild, being known as "Adra," and is cultivated to a small extent as "Garawi." The Sudan plant has hitherto been classified as *Andropogon halepensis*, but the United States authorities regard it as a variety of *A. sorghum*. Trials at numerous places in the United States have demonstrated that this grass promises to be of great value in semi-arid regions. Under somewhat more humid conditions it surpasses foxtail millets, producing more and better hay. Individual plants under favourable conditions grow to a height of 10 ft., and may possess twenty or more stalks about the thickness of a pencil. When sown broadcast or in drills the height averages 3 to 4 ft., the stalks are finer, mostly unbranched, erect and leafy. The grass is stated to be very palatable, but until the feeding trials have been completed no definite statement as to its feeding value can be made.

Oils and Oil Seeds

Candle Nut Oil.—Results of the examination of this oil, obtained from the nuts of *Aleurites triloba* (= *A. moluccana*), known in Hawaii as the kukui tree, are given in *Journ. Indust. and Eng. Chem.* 1913, **5**, 644 (cf. this Bulletin, 1907, **5**, 135). It is stated that the cake cannot be used as a fodder, as it has a poisonous effect on cattle.

Aleurites triloba is known in the Philippine Islands as "Lumbang" (*Tropical Life*, 1913, **9**, 214). Owing to the valuable drying and other properties of the oil, it is in great demand, but producers in the Philippines are unable to accept orders from foreign merchants, since the supply of nuts is uncertain and the mills are for the most part small and antiquated. It is suggested that Philippine planters should endeavour to develop the trade in this oil by systematic plantation of the trees.

Castor Seed.—According to *L'Agronomie Coloniale* (1913, **1**, 15) there is scope for greatly extended cultivation of castor seeds in Senegal and the French Sudan. Hitherto planters have been handicapped by lack of suitable transport facilities. Results are given of the examination of various samples of castor seed from French West Africa.

Coconuts.—The cultivation and manurial requirements of coconut trees in the Seychelles are discussed by Dupont in *L'Agric. prat. des pays chauds* (1913, **13**, 345). Two kinds of soil exist in the Seychelles, the first formed by disinte-

gration of granitic rocks, the second a coral-sand soil, in both of which potash and nitrogen are deficient. The coralline soils common in the outlying islands contain phosphates derived from bird guano and are very fertile, but require the application of potassium sulphate. On the granitic soils the application of a ton of guano per hectare every five or six years, and 100 lb. of potassium sulphate every year, should suffice for coconuts. Guano is readily obtainable at Victoria, while potassium sulphate is obtainable at Colombo for 185 rupees per ton, and is cheaper per unit of potash than kainit. The granitic soils also require lime to neutralise acidity. The cultivation of leguminous crops as a source of nitrogen is recommended.

A general article on the coconut beetles, *Oryctes rhinoceros* and *Rhyncophorus ferrugineus*, is published in the *Gardens Bulletin, Straits Settlements* (1913, 1, 176). The occurrence of these beetles in the principal coconut-growing countries is described. Particulars are given of the methods employed for destroying these pests, and the provisions of the local Ordinances against them are summarised.

In the Solomon Islands 25,000 acres are now planted with coconuts, excluding native plantations (*Colonial Repts. Ann. Series* [Cd. 7050–15], 1913, p. 16), but there is a scarcity of labour. The methods of planting differ from those employed in the eastern plantations, where the young plants remain for a year or more in the nursery; it is considered better in the Solomon Islands to transplant much sooner, in fact before the rootlets have pierced the husk, in order to avoid damage to the young roots.

The leaf-eating larva of a beetle (*Brontispa Froggatti*) caused a good deal of damage formerly, but does not seem to have been much in evidence during recent years. Attempts were made to eradicate the beetles by importing Australian magpies and Indian mynahs to eat the beetles, but these birds do not appear to have increased to any great extent; treatment with insecticidal washes has been employed with greater success. Two species of boring beetles, *Xylotrupes nimrod* and *Trichogomphus semelinki*, have also caused some damage, and it is suggested that flamboyant trees (*Poinciana regia*), to which the beetles are attracted, should be planted. The bud-rot disease is stated to have occurred in one or two places, but the effects of lightning may have been mistaken for this disease. In the preparation of copra, kiln-drying will probably replace open-fire drying altogether in the future in the islands.

The use of a mixture of kerosene and tar in place of tar alone is recommended for destroying boring-beetles on coconut palms (*Trop. Agriculturist*, 1913, **41**, 188), as being easier to apply owing to its greater fluidity.

Oil Palm.—The Commercial Intelligence Officer for Southern Nigeria has collected the following information regarding the working of the oil palm by natives in that colony (*Nigerian Customs and Trade Journal*, 1913, **3**, 360). Palm kernels are fully worked in many districts and an increased production can only be obtained by further planting. In districts where the kernels are not exploited fully it is suggested that transport facilities should be improved, and that nut-cracking machines should be introduced. Palm oil is used as food in almost all the districts, from about 2 to 8 gallons per head per annum being the usual amount, but in two districts the consumption is stated to be 20 and 28 gallons respectively. Palm kernel oil is made in a number of districts, but the kernels do not appear to be used as food to any appreciable extent. Canoes seem to be lacking in a number of districts, with consequent hindrance to transport.

The results of further investigations on the oil palm in the Misahöhe district, Togoland, are given by Gruner in *Der Tropenpflanzer* (1913, **17**, 353). The annual yields of palm fruits in a plantation are being recorded, but these records have not been kept long enough for any conclusive results to be obtained. The yields for the first seven months of 1912 are somewhat low, about 22½ lb. of fruit per tree ("Ede" variety) being obtained, probably owing to the excessive drought of the preceding year. Diagrams correlating the rainfall and yearly output of oil and kernels show that an increased output generally follows for one or even two years after a year of high rainfall.

Sesamum Seed.—Owing to exceptional rains in Kordofan, exports of sesamum from the Sudan in 1912 were greater by 1,000,000 kilos. than in 1911. High prices were paid, and it is stated that the cultivation of sesamum in the Sudan should increase with the extension of irrigation (*Annual Report Cent. Econ. Bd. Sudan*, 1912, No. 6, p. 42).

Miscellaneous.—The seeds of *Dilobeia Thouarsi*, Roem. and Schult. (N.O. Proteaceæ), a tree occurring in Madagascar, contain 64 per cent. of a yellow oil, which at normal temperatures deposits a quantity of solid white "stearin" (*Journ. d'Agric. trop.* 1913, **13**, 250): it is stated that the thick shell of the seeds would render them unsuitable for commercial exploitation.

The results of the examination of seeds of *Carya amara* or swamp hickory and *C. ovata* or shellbark hickory are given in *Journ. Indust. and Eng. Chem.* (1913, **5**, 739). Kernels of *C. ovata* contain about 70 per cent. of oil. By cold pressing, followed by hot pressing, a yield of nearly 50 per cent. of oil was obtained. The oils from both varieties of nuts give very similar analytical con-

stants, closely resembling those of cotton-seed oil. They possess an agreeable hickory nut flavour, and could be used as edible oils. At present the nuts from *C. amara* are considered valueless, and are fed to pigs; it is suggested that the possibility of manufacturing the oil on a commercial scale should be further investigated.

Decorticated seeds of *Jatropha mahafalensis* contain about 60 per cent. of oil (*Journ. d'Agric. trop.* 1913, **13**, 250). By pressing, 44 per cent. of a mobile, amber-coloured oil is obtained, which has an iodine value of 112 per cent.

Mafureira seeds (*Trichilia emetica*) are becoming better known in Europe, and a good demand has been met with from Marseilles soap manufacturers (*Dipl. and Cons. Rep.* No. 5,210, 1912 [Cd. 7048-26]). The exports from Portuguese East Africa in 1912 are estimated at 2,000 tons, the value at Marseilles being £11 per ton c.i.f. (cf. this BULLETIN, 1911, **9**, 406).

Investigations of the fruits and seeds of *Mimusops Djave* seem to show that there is no poisonous constituent present (*Der Tropenpflanzer*, 1913, **17**, 399), but the question of the toxic action of the seeds is still left open, since the age of the tree is said to exert some influence on the nature and quantity of the glucosides present.

According to the *Board of Trade Journal* (1913, **83**, 308, 425) a factory is shortly to be opened at Sandefjord, Norway, for the purpose of hardening whale oil by a new Austrian process which differs from that adopted by the Fredrikstad company (see this BULLETIN, 1913, **11**, 663). The company will have the sole right in Norway of working the Hydrier method of hardening and treating oils and fats; and is arranging for an annual output of from 12,000 to 15,000 tons of the finished product.

ESSENTIAL OILS

Ocimum spp.—Oils derived from two species of Ocimum, and prepared at Dabakala, Ivory Coast, have been examined by Roure-Bertrand Fils (*Bulletin*, October 1913, p. 17). The oil of *Ocimum canum*, Sims (*O. americanum*, L.) was at ordinary temperatures a crystalline mass, owing to the separation of methyl cinnamate, which constituted about 87 per cent. of the oil. The liquid portion of the oil was composed apparently of hydrocarbons, and gave an optical rotation of $-3^\circ 24'$. The oil of *O. gratissimum*, L., was golden-yellow in colour, and possessed an odour resembling that of ajowan seed oil. The specific gravity was 0·9105, and optical rotation $+0^\circ 58'$. It contained 44 per cent. of phenolic constituents, consisting almost entirely of thymol. In this respect the oil resembles that of *O. viride*, Willd., a sample of which, examined at the Imperial Institute, contained 32 per cent. of thymol (see this BULLETIN, 1908, **6**, 209).

Cyprus Origanum Oil.—The *Cyprus Journ.* (1913, No. 31, p. 717) mentions that experiments on the cultivation of the Cyprus origanum plant are now being conducted by the Agricultural Department. A brief statement is given as to methods of cultivation. Owing to its strong antiseptic properties (this BULLETIN, 1910, **4**, 407, and 1913, **11**, 50), there is a good demand for this oil; the price in England was stated to be more than 12*s.* per oke (2·8 lb.) in 1912. It is estimated that, after the first year, a yield of about 40–60 okes of the oil would be produced annually per Cyprus scala (1,600 sq. yds.).

RUBBER

Funtumia elastica.—According to the *Ann. Rept. Forest Administration Southern Nigeria for* 1912, trees in the Ibadan and Mamu reserves were tapped by the half-herring-bone system to a height of 20 ft. on half the circumference; 3,501 lb. of dry rubber were obtained, including 66 lb. of scrap, the first-quality rubber being sold locally at 3*s.* 10*d.* per lb. In the Central Province 38,147 trees of 18 in. girth and over were tapped, but an average yield of only 1·138 oz. per tree was obtained; most of the rubber obtained sold locally at 3*s.* 4*d.* per lb.

Hevea brasiliensis.—The advantages of the basal or single V system of tapping are pointed out in the *India-Rubber Journ.* (1913, **46**, No. 26, p. 19). This method has been proved to give high yields of rubber, and is now being employed on practically all the estates in the northern part of Malaya. Four years are allowed for bark renewal. As the tapping is not extended above 3 ft. from the ground, children can be employed, and 400 to 450 trees can be tapped per diem by one tapper. It is stated that less scrap rubber is produced by this system than by the quarter or half-herring-bone systems.

Attempts are being made to improve the methods of preparing Para rubber in the Amazon rubber districts by the introduction of a simple apparatus for coagulating the latex (*Journ. d'Agric. trop.* 1913, **13**, 329). The apparatus consists of an easily portable aluminium drum designed to take the place of the wooden paddle or pole employed by the "seringueiros"; the method of coagulation consists in applying the latex to the surface of the drum, which is then exposed to smoke in the usual manner, the process being repeated until a sheet of rubber from $\frac{1}{8}$ in. to $\frac{1}{5}$ in. in thickness is obtained; the sheet is then removed from the drum and dried. The rubber produced is said to be of excellent quality, is drier than fine hard Para, and only loses from 3 to 7 per cent. on washing. The process is said to be rapid, one hour being sufficient to coagulate

12 litres of latex, compared with about one and three-quarter hours taken by the usual process.

The use of sodium bisulphite for the production of pale-coloured plantation rubber is described by Beadle, Stevens, and Morgan (*India-Rubber Journ.* 1913, **46**, No. 5, p. 14). The process is cheap and effective; the results of tests on vulcanised samples of the rubber prepared show that no injurious effect is produced on the quality of the rubber.

The establishment of a department for testing plantation rubber is under the consideration of the Rubber Growers' Association (*India-Rubber Journ.* 1913, **46**, No. 24, p. 19). The object of such a department would be to submit samples of rubber to scientific and technical tests, which would replace the present inadequate method of valuation by brokers. An experimental factory in connection with the testing department would be advantageous, as technical work could be carried out for the information of manufacturers, and for the purpose of determining new uses for plantation rubber (cf. this BULLETIN, p. 76).

Manihot spp.—The results of experiments on the tapping of Ceara trees at the Malang experiment station, Java, are recorded by Dr. Arens in the *Mededeelingen* No. 6 *van het Proefstation Malang*, 1913. Eight groups of ten trees, 3½ to 4 years old, and of an average circumference of about 26 in., were used for the experiments, the outer bark being removed, as is usual in tapping Ceara trees. Group 1 was tapped by the Bamber-Sandemann system; in this method a shallow, vertical groove is made in the cortex, and short, horizontal cuts are made along the groove by means of the four-bladed Bamber pricker and a mallet, the next tapping being made similarly about ⅔ in. from the previous groove. High yields were obtained at the commencement, the first ten tappings giving an average of 3·06 grammes per tapping, but the process possesses the disadvantages that the number of incisions is so large that trees cannot be tapped for more than four months, and require nine months' rest, while a native can only tap twenty trees in an hour; there is also risk of damage to the tree.

Groups 2 and 3 were tapped by the Zuidergebergte method, in which a vertical cut is made through the cortex to the cambium, and running the length of the stem, the latex being collected in a cup at the base. Subsequent tappings are made similarly at distances of 1 in. In group 2 the incision was made with a knife, but the incisions opened widely and formed broad wounds; in group 3 a pricker was used, but the pieces of cortex between the pricker-cuts eventually split, forming similar wounds to those produced when a knife was used. The yield by this method was small, about 1·2 grammes per tapping for twenty-five tappings being obtained.

Groups 4, 5, 6 were tapped by methods usually employed for *Hevea* trees. In group 4 the half-herring-bone system, with three cuts 18 in. apart renewed daily, on one-third of the circumference, was used. This method gave a lower yield than the Bamber-Sandemann system, but the yield of rubber did not fall off so rapidly, while a native could tap 200 trees in a day. In group 5 the same system was used, but narrow strips of cortex were left between the daily cuts. This method gave a very small yield, while the bark consumption was four or five times as great as in group 4. In group 6 the herring-bone method was employed, using a pricker; this did not increase the yield.

Dr. Arens concludes that the half-herring-bone method is the best of those tried, but that a vertical channel is not needed. A thousand trees, three to five years old, were tapped daily for three months by this method, three cuts, 18 in. apart, being made on one-third the circumference; previous to tapping, strips of outer bark about 4 in. wide were removed. For the whole period of three months 4½ oz. of rubber per tree were obtained.

Experiments were also made to ascertain the influence of the number of tapping cuts and of the length of cut on the yield, and the yield at different heights.

With good tapping the bark renewal of Ceara trees is more rapid than that of *Hevea*; three years are said to be sufficient for Ceara trees. When tapped by the herring-bone system, the renewed cortex is stated to be as thick one year after tapping as the original cortex, and to give an abundant flow of latex.

A new method of tapping introduced by Migdalski in German East Africa is said to be giving satisfactory results (*Der Pflanzer*, 1913, **9**, 473). The method obviates the tedious removal by hand of the rubber from the cuts on the trees. A piece of strong, coarse cloth, 28 in. long and about 5 in. wide, which has been previously soaked in acetic acid or other coagulating solution, is applied to the tapping cuts and patted down by hand; it is then stripped off, and carries the rubber with it. The rubber can be removed easily from the cloth when about 10 oz. have been collected. The method possesses the advantages of requiring a smaller number of cuts, and less skill, while the amount obtainable by one man in a day was found to be 780 grammes compared with 280 grammes by the usual Lewa method; the rubber produced is cleaner.

Manihot dichotoma has failed to give satisfactory results at Peradeniya, Ceylon (*Trop. Agriculturist*, 1913, **41**, 278): 354 trees, stabbed four days running every fortnight in June and July, only yielded 5 lb. of rubber.

Ceara rubber produced on the Government farm at Kegalu, Mongalla Province, Sudan, sold in London at 4*s.* 4½*d.* per lb. with "fine hard" Para at 4*s.* 10¾*d.* (*Ann.*

Rept. Cent. Econ. Bd. Sudan for 1912, p. 45). The Ceara plantations at Sennar made good growth in spite of the poor rainfall. *Manihot dichotoma* and *M. piauhyensis* are also growing well here, and are free from fungoid diseases, such as have attacked and destroyed some 200 trees of *M. Glaziovii*. In the Government reserve, Sennar, 460 acres have been divided up into 20-acre plots, with roads 15 ft. wide; the 6 miles of road have been planted with Ceara rubber trees 9 ft. apart, and 25,000 trees have been planted in three of the blocks. The trees are in good condition; the total number of trees, including those planted in 1911, was 65,000.

Fibres

Sisal and Mauritius Hemps.—The cultivation of experimental plots of Sisal and Mauritius hemp plants at various altitudes in Nyasaland has shown that the higher localities are too cold, and that the most profitable results are obtained below 2,500 ft. In the *Ann. Rep. Dept. Agric., Nyasaland Protectorate, for the year ending March* 31, 1913, it is stated that there are now 856 acres devoted to Mauritius hemp, and 152 acres to Sisal hemp, and it is expected that the area will shortly be extended. A "New Corona" machine for preparing the fibre has been installed in the Blantyre District, and during the year under report about 60 tons of Mauritius hemp were extracted. The fibre was of good quality, and realised £29 5s. per ton in the United Kingdom. The plants were very small, and the yield of dry fibre amounted to only about $1\frac{3}{4}$ per cent. of the weight of the fresh leaves.

The cultivation of Mauritius hemp (*Furcræa gigantea*) in Natal has now attained a position of commercial importance, and appears to be a very promising industry. It is stated in the *Board of Trade Journal* (1914, **84**, 44) that about 15 tons of fibre are exported each month, and that this output might be considerably increased if superior machinery were introduced. About 1,000 acres are now devoted to the crop, and the average yield is about 1 ton of fibre per acre. The product has been realising very good prices on the London market, and compares favourably with that derived from other countries.

Paper-making Materials.—There are enormous areas in Northern and Central India covered with waste grasses which are at present of little or no economic value. An examination of some of the more important of these plants has been made by Mr. W. Raitt, of the Forest Research Institute, Dehra Dun, and his results are embodied in a "Report on the Investigation of Savannah Grasses as Material for the Production of Paper-pulp," which has been published recently as *Indian Forest Records* (vol. v., part III). It has been found that each of the following

grasses yields a pulp of first-class quality, and that they can be treated in admixture with one another without reducing the value of the product: *Saccharum spontaneum*, L.; *S. arundinaceum*, Retz; *S. Munja*, Roxb.; *S. Narenga*, Wall.; *Anthisteria gigantea*, Cav., sub-spp. *arundinacea*, Hack., and *villosa*, Hack.; *Arundo Donax*, L.; *Phragmites Karka*, Trin. These pulps all possess good strength, bleaching capacity, and felting power. The five following species are somewhat inferior to these in quality and strength of fibre, but may be mixed in moderate quantities with the eight species mentioned above without materially deteriorating the yield and quality of the pulp: *Saccharum fuscum*, Roxb.; *Andropogon intermedius*, Br.; *Vetiveria zizanoides*, Stapf; *Andropogon Nardus*, L. (forma *normalis*, Hook. f.); *Erianthus Ravennæ*, Beauv. The following are still more inferior, and are rather difficult to bleach, but may be used in admixture up to 10 per cent. without detriment to the product: *Imperata arundinacea*, Cyrill; *Eragrostis cynosuroides*, Beauv. Only three grasses were found to be unsuitable for mixing with those of the first class, viz. *Andropogon contortus*, L.; *Aristida cyanantha*, Steud.; and *Triraphis madagascariensis*, Hook. f. To obtain maximum yields of pulp, the grasses should be cut when in flower. *Saccharum arundinaceum* gives an average annual crop of about 14·8 tons of dry grass per acre, which is twice as great as that of any other species. Analyses of the grasses are given, particulars of the method of preparing the pulp are supplied, the length and diameter of the ultimate fibres are recorded, and costs of production of the pulp have been worked out.

Cotton

Reference has been made in this BULLETIN (1913, **11**, 143) to the "Durango" variety of cotton, which was introduced into the United States from the boll-weevil infested regions of Mexico. This variety gives a large yield of seed-cotton which furnishes 31 to 32 per cent. of lint on ginning. The fibre is of uniform character, and $1\frac{3}{16}$ to $1\frac{1}{4}$ in. long. In *Circulars* Nos. 111 and 121 (1913) of the *Bureau of Plant Industry, U.S. Dept. Agric.*, an account is given of the introduction and cultivation of "Durango" cotton in the Imperial Valley, Southern California, where excellent results have been obtained, and where 6,000 acres were planted with it in 1913. This cotton has met a demand for a long-stapled variety adapted to the local conditions, and promises to be of great benefit to the farmers of the Imperial Valley. The plant produces large bolls, and the cotton is no more troublesome to pick than that of short-stapled varieties.

During the year 1913, Mr. O. F. Cook, of the Bureau of Plant Industry, U.S.A., observed the occurrence in Arizona

of a weevil, resembling the Mexican cotton boll-weevil, in the bolls of a wild shrub known as *Thurberia thespesioides* (= *Gossypium Thurberi*), which is closely allied to the ordinary cotton plant, and is known by the Mexican natives as "wild cotton." This new insect, *Anthonomus grandis thurberiæ*, and its life-history are described in the *Journal of Agricultural Research* (1913, **1**, 89). It has been found that the Arizona weevil can feed and multiply on the ordinary cotton plant, and that the Texas boll-weevil (*Anthonomus grandis*, Boh.) will readily attack Thurberia. The importance of the discovery lies in the fact that Thurberia plants have been observed in the vicinity of the Santa Cruz Valley, and within ten miles of cotton plantations which were only established in 1913, and which will probably be greatly extended during the present year. The ordinary Texas weevil has not yet successfully invaded the drier cotton regions of Western and North-Western Texas, but it is believed that the Thurberia weevil could withstand the rigorous climate of these areas, and might inflict great damage on the cotton crop. It is therefore necessary that every effort should be made to prevent the introduction of the new pest into Texas.

Considerable damage has been effected during recent years in certain parts of the United States by the minute reddish mite (*Tetranychus bimaculatus*), commonly known as the "red spider," which infests the under surfaces of the leaves of the cotton plant. An account of the life-history of this pest and of the methods of controlling its ravages has been given in *Circular* No. 172 (1913), *Bureau of Entomology, U.S. Dept. Agric.* The attack is manifested by the appearance of blood-red spots on the upper surfaces of the leaves; the leaves gradually fall off, and eventually the plant dies.

Grenada.—The cultivation of cotton was an important industry in Grenada in the eighteenth century, but was subsequently abandoned. There is a large area, probably not less than 2,600 acres, of land, at present uncultivated, which appears well adapted for the crop. During recent years several attempts have been made to revive cotton-growing in Grenada, and reference to these efforts is made in an article in the *West Indian Bulletin* (1913, **13**, 358). All these attempts to re-establish the industry have failed owing to the prevalence of a bacterial disease which attacks the bolls of both Marie Galante and Sea Island varieties. This disease does not seem capable of control by direct methods, but it is considered that, with a view to evading it, observations should be made as to the best time for planting, trials should be conducted with several different varieties of cotton, and hybridisation, selection, and manurial experiments should be undertaken. A series of ex-

periments has been planned which, if systematically carried out, would probably furnish valuable information.

Nyasaland.—Cotton still continues to be the most important crop grown in Nyasaland. In the *Ann. Rep. Dept. Agric., Nyasaland Protectorate, for the year ending March* 31, 1913, it is stated that there are *25,697* acres under cultivation, and that during 1912–13 the exports amounted to 8,093 bales of 400 lb., as compared with 3,392 bales in the previous year. It is considered that, owing to the insufficiency of native labour and the primitive system of cultivation now in vogue, the acreage under European management is not likely to undergo much further increase at present; but it is anticipated that when the Protectorate has been connected by railway with the coast and Lake Nyasa the number of settlers will increase, and the estates will become better equipped. The native cotton industry is gradually increasing, but the production by the natives during the year under report amounted to only 1,126 bales of 400 lb. as compared with 1,454 bales in 1911–12, this diminution being due to severe drought which prevailed in the Lower Shire and Ruo Districts, where most of the native cotton is produced. An attempt has been made in the Mlanje and Upper Shire Districts to encourage the native growers to grade their cotton, and Government markets have been established in which the cotton is inspected and weighed by officers of the Government before being offered for sale. This experiment has been so successful that it has been decided to apply the same system to all the cotton-growing districts. In order to provide the necessary funds for establishing and maintaining the markets, purchasers are required to obtain a licence (costing 10*s*.), and to pay market fees at the rate of 3*d*. per cwt. of seed-cotton purchased. By arrangement with the British Cotton Growing Association a small premium has been guaranteed to natives who grade their cotton. The advantage of grading the product is that better prices are secured for the ginned cotton, and that it obviates the exportation of large quantities of inferior or unsaleable cotton, and consequent loss to the exporter. The Department of Agriculture is paying attention to the quality of the seed supplied to the natives for sowing, and the production of carefully selected seed on the Government farms is being continued.

Erythræa.—The cultivation of cotton was commenced in the Italian Colony of Erythræa in 1904. During the first two seasons attempts were made to grow Egyptian varieties, but subsequently it was found that American kinds gave much better results. A short account of the industry was contributed by Mr. A. Moretti to the "Ninth International Congress of Delegated Representatives of Master Cotton

Spinners' and Manufacturers' Associations" in 1913, and has been published in the *Official Report* of the Congress (p. 357). A variety of American cotton, known as "Carcabat" from the native name of the place where it first appeared, has a length of 1⅛ to 1⅜ in., and is fine, silky, and fairly strong. Consignments of this cotton have been sold in Liverpool at 8½*d.* per lb., with "middling" American at 6·62*d.* per lb. The industry has encountered certain difficulties on account of the war with Turkey, but it is hoped that ere long these will have disappeared. Attention is being directed to the possibility of irrigation and the development of railways, and it is anticipated that in virtue of the favourable climatic conditions and the intelligence of the natives, it may be possible to produce large quantities of cotton in Erythræa.

Tripoli.—On p. 358 of the Report just mentioned reference is made to experiments which are being undertaken in Tripoli with certain American Upland cottons, including "Mebane" and "King" varieties.

Asia Minor.—During the Congress referred to above a report was made on the progress of cotton growing in the Levant (*Official Report*, pp. 324, 325), in which it was stated that in the seasons 1911–12 and 1912–13 the crop increased considerably in quantity, and also showed a decided improvement in quality. This advance is due to the increasing care bestowed by the peasants on the cultivation of the crop, and to the use of improved ginning machinery. The industry has suffered considerably owing to the labourers being recruited as soldiers, and on account of other difficulties occasioned by the Turco-Italian war. Further obstacles to the development of cotton-growing were the subsequent Balkan war, political and economic troubles, and the occurrence of a plague of locusts in the Smyrna hinterland.

Tobacco

Tobacco Wilt.—The results of the investigation at Pusa into the cause of the tobacco wilt disease, which recurs annually in the Rangpur district of Bengal, are recorded in *Memoirs Dept. Agric. India, Bacteriological Series* (1913, I, No. 2). The disease is due to a bacterium similar to *B. solanacearum*, Smith, which causes the Granville tobacco wilt of the United States. The infection enters the plant at a point of mechanical injury, or through the intervention of such organisms as nematodes, which bore into the root or collar of the plant. Transplanting and the removal of lower leaves provide occasion for the former class of wounds. The author rejects the generally accepted theory that the wilting effect is due to the plugging of the vessels

by masses of bacteria, and consequent interference with the water current in the plant, and considers it to be due to the action of secreted toxins on the protoplasm. Hot-weather ploughing is advocated in order to aid the destruction of the bacteria, which do not survive a temperature of 50° C. This treatment also conserves soil moisture and favours root development, producing stronger and more disease-resistant plants. It is stated that an alkaline reaction in the soil encourages the growth of *B. solanacearum* by enabling it to overcome the unfavourable acidity of plant juices; on this account, manures producing an alkaline reaction in the soil should be avoided.

DRUGS

Belladonna.—The *Journ. Agric. Research* (1913, **1**, 129) contains an article by A. F. Sievers on "The Individual Variation in the Alkaloidal Content of Belladonna Plants." The author describes a large number of experiments which were carried out as a preliminary step towards the application of methods of selective breeding to the belladonna plant, with a view to increasing the amount of alkaloid present in the leaves. The object of the experiments was to correlate, if possible, the alkaloidal content of a plant with (1) its stage of growth, (2) its size and appearance, and (3) soil and climate. Experimental plots were grown at Arlington, Va., Bell, Ind., and Madison, Wis. Plants were selected at random from the plots, and leaves from each were picked at different times during the growing season, in order to determine the time of year at which the leaves contained the greatest percentage of alkaloids. The physical appearance of each plant was also noted, the distinguishing features in this case being the height of the plant and the number of stems. Immediately after picking, the leaves from each individual plant were air-dried separately and the amount of alkaloid present determined. Further analyses were performed in order to investigate the variation in the alkaloidal content of the leaves of individual plants. The general results arrived at indicate that the best time for picking the leaves is from the time of flowering until the early berries begin to ripen; for, although the leaves are richer in alkaloids later in the season, they are then too few and small for harvesting. No indication was found of any relation between the physical appearance of a plant and the alkaloidal content of its leaves. It was found, however, that a considerable number of plants with leaves rich or poor in alkaloids in one season bore correspondingly rich or poor leaves in the following season. Furthermore, the plants frequently manifested the same characteristics at the various stages of growth during one season as during the previous season.

Buchu.—The culture of the buchu plant is the subject of an article by G. R. von Willeigh in the *Agric. Journ. Union of South Africa* (1913, **6**, 80). The author points out that, although the price of the exported leaf rose about 500 per cent. during the years 1908–12, the exports from South Africa diminished from 243,742 lb. to 223,021 lb. in the same period. This he ascribes to careless methods of culture and collection, and also to the destruction of seedlings and young plants by veld fires. It is stated that the adulteration of buchu leaves has also caused a diminution in the demand for this drug. The article gives a description of experiments, carried out by the author, in the cultivation of mountain buchu (*Barosma betulina*) and the kloof or fountain buchu (*B. serratifolia*). From these experiments the author concludes that the latter variety possesses greater vitality and is easier to cultivate than the former. The varieties and uses of the drug are described, and directions for its cultivation are given.

FORESTRY AND FOREST PRODUCTS

According to Mr. H. H. Corbin (*Journ. Dept. Agric. South Australia*, 1913, **17**, 152), the value of timber imported oversea by South Australia in 1911 was £386,707. The timber sawn amounted to over 45 millions super ft., valued at £520,315. Timber to the value of £12,356 was used as pit props in mines during 1912, an increase of about £1,000 on the previous year's figures. Timber used for sleepers in the State is rapidly decreasing in quantity, and numbers of these are now imported. The number of jarrah wood paving blocks used in Adelaide up to December 1912 was 1,595,800, costing £16,755.

As regards the wattle bark industry, it is pointed out that in certain years Australia does not produce bark in sufficient quantities for its own consumption, and imports a considerable quantity from Natal. In 1910–11 the production of wattle bark in South Australia amounted to 6,598 tons, and in 1910 bark to the value of £15,208 was exported oversea. The price of wattle bark in 1912 was £7 per ton, and the average annual production 7,000 tons. The industry is much handicapped by the scarcity and high cost of labour. In Natal, where the climate is good and labour is cheap, the industry is developing steadily, and there is no doubt that South Africa is gaining what the Commonwealth is losing in this industry.

According to the *Annual Report for* 1912 *of the Director of Queensland Forests*, the area in that State temporarily reserved at the end of the year was 3,211,855 acres, an increase of 343,518 acres on the figures for the previous year. Despite the depression reported to exist in the sawmilling industry in the latter half of 1912, the figures for

the year showed no decline on the previous year's figures except in the cases of milling hardwood and cypress pine. The number of sawmills in operation during the period covered by the *Report* was 258; the amounts and values of the timbers cut were as follows: softwoods, 107,780,777 super ft., value £829,617; cedar, 885,791 super ft., value £19,850; hardwoods, 55,160,910 super ft., value £478,015. All these figures show a substantial increase on those of the previous year. The timber revenue for the year amounted to £63,446, as compared with £53,840 in 1911.

Casuarina.—Reference has previously been made in this BULLETIN (1913, **11**, 357) to the plantations of *Casuarina equisetifolia*, on the sea-coast of the Bombay Presidency, which have been formed for the production of fuel. On this subject a correspondent contributes to the *Indian Forester* (1913, **39**, 380) an account of the methods employed in the Kolaba district, which have given good results. In order to avoid the labour involved in watering the seedlings during their first years in the plantation, they are kept in specially constructed nursery beds for from 12 to 18 months prior to planting out, and are then found to succeed without artificial watering. The nursery beds employed consist of a wooden platform, 4½ ft. square, made of casuarina branch-wood latticed together and supported on four wooden posts, 9 in. thick, that stand 2½ ft. above ground. A layer of soil 10 in. deep is formed on the platform, and in this the seed is sown. A bed of the dimensions stated will accommodate from 500 to 700 seedlings, which, at the end of from 12 to 18 months, have an average height of 5 ft. By loosening the lattice-work of the platform the seedlings can readily be removed for planting without injury to the roots. The planting out is done about a week after the break of the monsoon, in holes 18 in. deep, formed at the time of planting. Prior to the year 1911 a spacing of 6 ft. was adopted, but more recently the spacing has been 12 ft. apart, in squares or triangles. Stakes are necessary to support the plants for the first two years after planting out. Another method which has been employed with success consists in transferring seedlings from the nursery bed, when 6 months old, to locally made earthen pots measuring 9 in. in diameter and 6 in. in depth, in which they remain until 18 months old, when they are planted out as above described. The pots can be used repeatedly. The roots are not damaged by this method, and the subsequent growth of seedlings is very rapid.

Eucalyptus.—A note on the plantations of blue gum (*Eucalyptus globulus*) in the Nilgiris, prepared by Mr. R. S. Troup, of the Forest Research Institute, Dehra Dun, forms the subject of the *Indian Forest Records* (1913, **5**, pt. ii.). As early as 1843 experimental plantations were started with

a view to replacing the natural forests which had been destroyed to supply the demand for fuel created as a result of the establishment of European settlements. It was not, however, until 1856 that plantations of blue gum on an extensive scale were formed; this species having been found the most valuable as a fuel tree. Plantations either pure or mixed with wattles (*Acacia dealbata* and *A. melanoxylon*) are now to be met with everywhere, belonging either to the Government or to private owners, and as a result fuel is considerably cheaper in the Nilgiris than in any of the Himalayan Hill stations which draw their supplies from natural forests.

The eucalyptus plantations are situated chiefly in the neighbourhood of Ootacamund, Coonoor, and Wellington, at elevations varying from 5,500 to 8,400 ft.; the best being at from 7,200 to 8,000 ft. The climate of this region is fairly cool, equable and moist, with a well-distributed rainfall of about 50 to 80 in.; although frosts occur, the winters are mild on the whole, and snow is unknown. The soil, a red clay overlying gneissose rock, is rich and deep in some parts, shallow and poorer in others.

The sylvicultural management of blue gum consists in raising seedlings in a nursery in beds of well-dug soil, free from gravel, and raised slightly, so as to afford good drainage. When about 3 in. high the seedlings are transplanted into other beds and spaced 3 in. apart, and when 6 in. in height they are transferred singly to bamboo baskets, 12 in. in depth by 9 in. in circumference, filled with light, rich soil. As soon as the baskets are filled with roots the seedlings are planted out, with their baskets, in pits measuring 1½ ft. cube, which are opened about 3 months before the time of planting. In most plantations the spacing is 6 ft. by 6 ft., in others a spacing of 9 ft. by 9 ft. has been adopted. Taking into consideration the extra amount of labour involved and the larger number of seedlings required in planting out 6 ft. apart, there is overwhelming evidence in favour of the wider spacing. After being planted out the seedlings require no further attention beyond a slight covering of bracken during frosty weather. The blue gum coppices well after it has attained a girth of 5 ft., and the young coppice shoots grow rapidly; in the case of a coppice crop in the Coonoor Peak plantation a height of 45 ft. was attained in 4 years. The coppice coupes are worked on a 10-year rotation.

The blue gum produces fertile seed at an early age, and in some of the plantations natural seedlings have been observed. It is not possible to give the actual figures of the cost of planting and maintaining these plantations, but from an estimate included in the note, it appears that the initial cost of planting is approximately Rs. 65 per acre for 6 ft. by 6 ft., or Rs. 46 for a spacing of 9 ft. by 9 ft.; the

annual recurring expenditure is estimated at R. 1 per acre. The net money value of the produce of one acre of blue-gum coppice at 5 years is estimated at Rs. 70, at 10 years Rs. 199, at 15 years Rs. 331, and at 20 years Rs. 461.

The possibility of utilising species of eucalyptus as fuel-producers in connection with the lime industry in St. Lucia, West Indies, is suggested in the *Report on the Agricultural Department, St. Lucia*, 1912–13. Several species of eucalyptus, including *E. paniculata* and *E. robusta*, are already thriving well in the island, and in the Botanic Station two trees that were coppiced in 1901 have made shoots that at the present time measure respectively 104 and 81 ft. in height and 6 ft. 7 in. and 5 ft. 3 in. in girth at the base, an average rate of growth of 7·7 ft. per year. These satisfactory results justify the suggestion that trial plantings of eucalyptus should be made wherever fuel is required or wind-breaks are necessary.

In the island of Dominica, West Indies, a large collection of species of eucalyptus has been brought together at the Botanic Gardens, and experiments have been started with a view to ascertaining which species are the most suitable for planting in the island as fuel-producers. As a result of these experiments, the species recommended in the *Report of the Agricultural Department, Dominica*, 1912–13, for trial on estates, are *Eucalyptus tereticornis*, *E. citriodora*, *E. rudis*, *E. rostrata*, *E. cornuta*, *E. patentinervis*, and *E. oreades*. Also recommended, but of less vigorous growth than the foregoing species, are *Eucalyptus alba*, *E. Maideni*, *E. paniculata*, *E. saligna*, and *E. tessalaris*.

Sál (*Shorea robusta*).—An account of the economic value of *Shorea robusta*, prepared by Mr. R. S. Troup, F.L.S., Economist at the Forest Research Institute, Dehra Dun, forms the subject of the *Indian Forest Memoirs, Economy Series* (1913, **2**, pt. ii.). The Sál tree is an important constituent of Indian forests, and yields one of the strongest and most durable of Indian timbers. Of the total annua outturn of India and Nepal, estimated from the latest figures available at 8,120,551 cubic ft., some 2,549,766 cubic ft. were converted into railway sleepers, and the remainder employed in constructional work. Details are given as to the structure, methods of seasoning, strength, fissibility, and hardness of Sál timber, and of its durability under different conditions. According to Dr. Leather, the evaporative power (lb. of water at 212° F. evaporated by 1 lb. of wood) is stated to be 8·45, whilst the results obtained by Mr. Puran Singh, the Forest Chemist, give 9·188 for completely dried material. Amongst minor economic products of the Sál tree to which reference is made are the resin, obtained by tapping, and an edible fat derived from the seeds and employed locally to adulterate "ghi."

Sandalwood.—The experimental cultivation of sandal-wood (*Santalum album*) was continued in the Northern Circle, Madras, according to the *Annual Administration Rep. of the Forest Dept. of the Madras Presidency*, 1911–12, pp. 12, 29, but owing to drought there was great mortality amongst the seedlings immediately after germination, and also amongst the larger trees owing to the death of their hosts. In the Central Circle the results of the experimental planting of sandal, conducted many years ago, are now becoming apparent. In several of the forest reserves, sandal trees are now spreading naturally into surrounding areas from centres which were artificially planted in the first instance. This spread of sandal into fresh areas is important, and it has increased interest from the fact that immature trees extracted from the Kodur plantation, at a low level, have given a fair proportion of scented wood, which, on analysis, has been found to be in no way inferior in oil value to that grown on the hills.

Teak.—Particulars of experiments to ascertain the best means for inducing the natural regeneration of teak (*Tectona grandis*) are given in the *Rep. on the Forest Administration in Burma*, 1911–12, p. 30. The experiments were conducted in the Mohnyin and Bilumyo Reserves of the Katha Division. The area selected for the experiments were previously covered with teak, and at the end of the forest year 1910–11 there was a plentiful supply of seedlings due to natural reproduction. Portions of these areas were kept weeded, in accordance with the rules laid down in the working-plan, whilst other portions were left unweeded, and simply burnt over each year. The latter method was found to result in failures, whilst on the weeded portions the results are said to be very promising. It follows from these results that although natural germination may be successful, the subsequent establishment of teak by natural regeneration requires the aid of continual weeding and attention for some years, until the teak has outgrown all other vegetation. In the weeded areas it was observed that teak seedlings with the slightest over-head cover were very backward and covered with mud. This is attributed to the drip from the over-head leaves rather than to the shade. It is suggested in this connection that in future it would be advisable to sacrifice small teak trees in the interests of a uniform crop where it is found that seedlings have sprung up under their crowns.

The old regeneration areas in the Mohnyin Reserve were successfully burnt over during the hot season, and after burning all forked and crooked stems were cut out and coppiced. The result of this operation has been that healthy coppice shoots have been produced, and this tends to prove that satisfactory growths can be induced by cutting back after establishment.

Timber

Three new timber-yielding species occurring in the Annam mountains are described in *L' Agronomie Coloniale*, (1913, 1, 38, 76), by Ph. Eberhardt and M. Dubard. The first of these, *Wrightia annamensis*, is a small tree very abundant in Annam, as well as in Tonkin. The wood is used for making shoes, and also for the seals of the secondary mandarins, those of the higher mandarins being engraved on ivory. It resembles boxwood in structure. The second species, *Symplocos multiflora*, affords a timber frequently used for building purposes. The other species described is *S. Dung*, the wood of which is used for making ploughshares and harrows.

Cedar Woods.—A list of the various timbers to which the name "cedar" has been applied is given in *Kew Bulletin*, (1913, No. 6). The name was, in all probability, first used to designate the Cedar of Lebanon (*Cedrus Lebani*, Loud.), although the fragrant wood of this species is of little value except as fuel. Subsequently the name was applied to other trees that resembled the Cedar of Lebanon or to woods that possessed a similar fragrance. The "cedars" enumerated in the list number some fifty-seven species belonging to fifteen natural orders. Of these the most important is the true pencil-cedar (*Juniperus virginiana*, L.), which has a wide distribution in North America, and furnishes a wood that has no equal for the manufacture of pencils. Many of the other species mentioned furnish useful cabinet woods, but only two are referred to as substitutes for *J. virginiana* for the manufacture of pencils—namely, *J. barbadensis*, L., the Barbados or Southern red cedar, native to Southern United States and the West Indies, formerly extensively used for pencil making, but now becoming scarce, and *J. procera*, Hochst., the East African cedar, which promises to be of value as a pencil-cedar substitute when it becomes better known. The latter is already being exported to Europe from German East Africa, and specimens of the timber from British East Africa were favourably reported on by the Imperial Institute some years ago (this BULLETIN, 1906, **4**, 15).

Pine Timber in Great Britain.—The first two *Bulletins* issued by the University of Cambridge School of Forestry form part of a series by Messrs. E. Russell Burdon and A. P. Long, which it is intended to publish at intervals, giving the results of their work regarding the production and utilisation of Scots pine timber in Great Britain. The principal object of this research is to determine as closely as possible the economic possibilities of the tree, and to estimate the extent to which the timber, when grown under proper sylvicultural management, is capable of taking the place of foreign timber of the same class. The first *Bulletin*

gives measurements and calculations taken in woods of Scots pine at Woburn, Bedfordshire, on selected sample plots. The second *Bulletin* deals in a similar manner with trees at King's Lynn, Norfolk.

Tanning Materials

Mangrove.—A concession has recently been granted for the exploitation of the mangrove forests in New Caledonia, where the commonest species is a red mangrove, *Bruguiera Rumphii* (*Journ. d'Agric. Trop.*, 1913, **13**, 336).

Oak Bark.—Enquiries are being pursued by the Forest Research Institute in the United Provinces, India, with regard to the possibility of utilising Indian oak bark as a tanning material, either in the raw state or in the form of extract. The analyses given in the *Indian Forester* (1913, **39**, 420) show that the Indian oak barks compare very favourably with those of European species of oak as regards their tannin content. The highest yields recorded by the Forest Chemist are as follows: *Quercus pachyphylla*, 22·44 per cent. of tannin, expressed on the dry material; *Q. lineata*, 15·84 per cent.; *Q. incana*, 11·52 to 13·28 per cent.; and *Q. spicata*, 11·90 per cent. It is not considered likely that this material in the raw state will find a remunerative market in India, as it would have to compete with "babul" (*Acacia arabica*) bark and myrobalans, both of which can be supplied cheaply and in large quantities, and at the same time are richer in tannin. It is stated that if tanning extract can be made from Indian oak bark at a cost not exceeding £6 per ton, it can be put on the European markets at a price which will enable it to compete with the extract manufactured in Europe. At present, however, it does not appear that extract can be manufactured so cheaply in India, owing to the high cost of the collection and transport of the bark to a central factory; but information is being collected with a view to ascertaining if this cost can be lowered.

Quebracho.—An account of the quebracho industry in Paraguay is given in the *Leather Trades' Review* (1913, **46**, 748). The industry was commenced in Paraguay in 1889, and at the present time there are six factories with a total output in 1912 of 17,000 tons of tanning extract. Practically all the extract is exported, 40 per cent. going to North America and the rest to Europe. The demand for this material is stated to be increasing in consequence of the decline in the use of oak bark.

The raw material used in Paraguay for the manufacture of quebracho extract is the trunks and branches of the red quebracho tree (*Aspidosperma Quebracho-colorado*), and also of the "Urundey" or "iron" tree.

The recent revolution in Paraguay has considerably

interfered with this industry, but a slight impetus has been given by the alteration of the custom duties. The chief difficulty encountered appears to be the lack of sufficient labour.

For an account of the different kinds of quebracho occurring in South America see this BULLETIN (1912, **10**, 683).

Wattle.—The wattle bagworm (*Chalioides junodi*, Heylaerts) proved so very injurious to the wattle plantations of the New Hanover district of Natal in the summers of 1911 and 1912 that a study of this insect is being undertaken by the Division of Entomology with a view to devising methods for its control (*Agric. Journ. South Africa*, 1913, **5**, 838; 1913, **6**, 19, 198). The larva of this moth feeds on the leaves, and the defoliation leads to "bark-binding" and a reduction in the quantity of bark formed, amounting in very bad cases to as much as 75 per cent., but usually varying from 10 to 20 per cent. The damage, however, never appears to be so great that the bark is not worth harvesting. An account is given of the life-history of the pest and the influence of climatic conditions on it: the possibility of reducing its depredations is discussed.

Miscellaneous.—An account is given in *Der Tropenpflanzer* (1913, **17**, 463, 557, 619, 676) of the chief tanning materials available in, or that might be produced in the German African colonies, with the object of supplying the German markets with raw material for their leather industry. At present, Germany relies largely on foreign countries for these supplies. Among the materials described are mangrove, wattle and mallet barks, divi-divi pods, and gambier, of which the first two are the most important. Supplies of mangrove bark from German East Africa have already been put on the German markets. A number of other tanning materials are also found in these German colonies, but their low percentage of tannin prevents them from being used other than locally by the natives.

Gums

Sudan Gum.—The quantity of gum exported from the Anglo-Egyptian Sudan in 1912 constituted a record, being 19,615 tons, valued at £618,600, as compared with 14,357 tons, valued at £446,512, in 1911. This product is still the most valuable Sudan export, but it is thought that it will probably be outstripped in the course of the next few years by cotton and live stock (*Ann. Rep. Cent. Econ. Bd., Sudan*, 1912, p. 18). The trade in 1912 suffered from over-production owing to the fact that the high price at which gum had been selling for years past, combined with the comparative failure of food crops in Kordofan and other parts

of the country, induced the natives to collect gum in larger quantities. The output was also influenced by the new railway between El Obeid and Khartoum, which enabled the gum to be disposed of much more rapidly than in former years. This excessive supply caused the price in Europe to fall from 35*s.* to 40*s.* per cwt., in the beginning of the year, to 33*s.* per cwt. towards the end; at this figure the price has since remained.

To counteract the ill effects of this surplus production, the Government postponed the levying of the higher royalty rates on the gum from November 1st to December 1st. The royalty on gum was increased to help to defray the cost of the work, which is being undertaken for the conservation of the forests which have been exploited so rapidly in the last few years, and in some cases even denuded.

Results, other than those already mentioned, from the completion of the railway to El Obeid, were that the supplies of gum continued to arrive at Khartoum from the interior, as late as August, whereas in former years they ceased at the commencement of the rains in May; also large quantities of gum were consigned direct from El Obeid to Port Sudan for shipment, without going through Khartoum, whereby a saving in freight charges was effected.

A feature of the gum trade in 1912 was that the price of "hashab" gum from Gezira approximated that of "hashab" gum from Kordofan, instead of being considerably lower as in other years.

ECONOMIC MINERALS

Coal.—The Geological Survey of India has issued a new edition of V. Ball's "Coalfields of India" (*Mem. Geol. Surv. India*, vol. xli. 1913). The new edition has been revised and largely re-written by R. R. Simpson, Inspector of Mines. Since the issue of Dr. Ball's memoir in 1881, the coal-mining industry has made great progress, the extent of which has been noted in the reports on the mineral production made annually by the Director of the Geological Survey of India, and in Sir Thomas Holland's *Sketch of the Mineral Resources of India*, published in 1908. The following table gives some indication of the extent of this coal-mining development in India since 1881:

Year.	Production.	Imports.	Exports.
	Tons.	*Tons.*	*Tons.*
1881 . . .	997,730	805,924	1
1891 . . .	2,328,577	775,933	4,061
1901 . . .	6,635,727	237,435	587,871
1911 . . .	12,715,534	306,010	860,788
1912 . . .	14,706,339	552,249	897,194

Corresponding to this development in coal mining there have been great extensions in the railway system and increases in manufactures and foreign trade.

Of the imported coal, 77 per cent. is supplied by Great Britain, the rest being contributed in roughly equal amounts by Australia and Japan. In recent years attempts have been made to secure a market in India for Natal coal, but with no great success.

Wood fuel is still used on certain sections of the Indian railway system distant from sources of coal supply; the amount used, however, has diminished considerably in recent years, having fallen from nearly 400,000 tons in 1904 to 127,725 tons in 1910.

The coal deposits of India are of various geological ages, and all younger than the Carboniferous coal deposits of the United Kingdom. The oldest and by far the most important of the Indian deposits are those of Gondwana age (Permo-Triassic), which were formed about the same time as the Karroo deposits of South Africa. Coals of Jurassic, Cretaceous, and Tertiary ages also occur in India, and the Tertiary deposits are worked to some extent (see p. 123).

The memoir deals with the geological occurrence of coal in India, and gives a detailed account of the deposits. It includes a chapter on production, trade, and labour, and an exhaustive bibliography.

Copper Ore.—The New South Wales Department of Mines has issued a report by E. C. Andrews on the Cobar copper ore deposits (*Geological Survey, Mineral Resources*, No. 17, 1913). Cobar lies on a plain of denudation, the loftiest elevation in which is at a locality twenty miles S.E. of Cobar, and reaches 500 ft. Elsewhere the heights do not exceed 200 ft., and the surface is covered to such an extent by a sheet of surface detritus that no natural sections are to be seen. The oldest fossiliferous sediments in the area are those of the Cobar series, including conglomerates, limestones, quartzites, sandstones, cherts, and shales of Silurian age. To the west of the township of Cobar there occurs an enormous thickness of sandstones and shales of Devonian age. No unconformity has been found between the Silurian and Devonian beds, but the eastern Silurian members appear to have been thrust over and against the western rocks, and this thrusting is supposed to have taken place during the orogenic movement that closed the Devonian period in this area. The only igneous rocks exposed in the whole of the Cobar district are two small pipe-like intrusions of orthoclase porphyry that lie thirteen and fourteen miles respectively to the S.S.E. of Cobar.

The Cobar district contains many ore deposits, the chief of which are those of copper and gold. These copper

deposits are the most important in New South Wales, and equal, or even exceed in importance the famous Mount Lyell deposits of Tasmania and the Mount Morgan deposits of Queensland. The Great Cobar copper-ore bodies themselves consist of three large lenses of chalcopyrite in a pyrrhotite and magnetite matrix, with considerable admixtures of slate and quartz.

The general strike of the Cobar lodes is about north 15° to 20° west, and they occur as siliceous or ferruginous gossans arranged along parallel lines of weakness in the Palæozoic rocks. In the eastern division of the area the ores are siliceous, whereas in the western division they are basic. It is noted that the basic western masses lie wholly in slates and claystones, whilst the siliceous eastern bodies occur at the contact of slates and sandstones.

The lodes may be divided into two types, namely, those characterised by the development of chalcopyrite and pyrrhotite, and those characterised by the presence of iron pyrites, galena, and zinc-blende. The pyrrhotite veins have no definite walls, but appear to be cemented into the country rock, whilst the pyritic lodes have walls much more clearly defined, and are generally younger than the bodies containing pyrrhotite.

The most important vein system is that which passes through the properties of the Great Cobar and the Great Cobar North. The main outcrop consisted of three small lenses of gossan, the central one showing blue and green carbonate stains, the other outcrops being barren. Rich carbonates and oxides were found below the surface, and the lenses were found to be connected with others by siliceous but unproductive belts of ore. Mining operations showed that these small outcrops were only the upper portions of larger and more important lenses of ore than had been suspected at the surface. Near the ground-water level, the rich oxidised zone passed into large masses of chalcocite and chalcopyrite, associated also with red oxide. At a depth of 400 ft. the richest class of chalcopyritic deposit had disappeared, and a much leaner class of chalcopyrite gradually took its place.

The evidence on the whole is regarded as indicating that, during the period of active earth movement that affected this area, the strata were dislocated to a great depth, affording access to the mineralising vapours and waters given off from the heated rocks below. In the coarse-grained rocks silicification was pronounced, whilst in the fine-grained rocks basic replacements were effected. In the Cobar Gold lode the silica percentage is about 80, that of the copper about 1·3, and that of the iron 8. In the Great Cobar lode the percentage of silica is about 17, sulphur about 15, iron about 41, copper 2·6, and alumina about 7.

The movement accompanying the formation of the deposits appears to have taken place in two stages. In the first stage pyrrhotite, magnetite, chalcopyrite, and an iron silicate, were the characteristic products. The later movements appear to have been associated with the deposition of a completely different set of sulphides, namely pyrite, galena, and zinc blende; pyrrhotite and magnetite are absent from these later deposits.

The climate in recent geological times has become semi-arid. The water-level lies at a considerable depth below the present surface. Descending waters have oxidised the sulphides, and re-deposited the matter in solution partly as oxides and carbonates above water-level, and partly as sulphides at and near the water-level.

The Cobar mining field was discovered in 1869, and mining began in 1870.

According to the *Annual Report of the Department of Mines, New South Wales*, for 1912, the Cobar District ranks next to Broken Hill as a centre of metalliferous mining in New South Wales. The metal output for 1912 is given as follows: Gold 66,801 oz. fine, value £283,751; silver 275,861 oz., value £28,784; copper 6,848 tons, value £410,155; lead 1,420 tons, value £23,393; total value £746,083.

Petroleum.—In *Memoir* No. 29E, 1913, *Department of Mines, Geological Survey, Canada*, W. Malcolm deals at some length with the oil and gas prospects of the North West Provinces of Canada, and gives a bibliography of the subject. The plains of western Canada are underlain by a mass of nearly horizontal sediments resting on a pre-Cambrian base. In the eastern part of the plains a great unconformity exists between the Palæozoic rocks, which consist of limestones, dolomites, and shales, and the Cretaceous system, which consists of shales and sandstones; and the Dakota sandstones of Cretaceous age are found resting directly on Devonian limestones. In western Alberta, and in some parts of south Saskatchewan, the Cretaceous sediments are overlain by Tertiary deposits, and overlying all is a mantle of unconsolidated Pleistocene and Recent deposits. In the west, the gap between the Devonian and Cretaceous is filled up by Carboniferous, Triassic, and Jurassic deposits.

Prospecting for oil has been carried on in two different areas in the Pincher Creek district, south-western Alberta, but with no great measure of success. In northern Alberta the Dakota sandstone shows impregnations of a bituminous substance believed to be a petroleum product, and it is thought that liquid petroleum exists in this porous rock at some distance from the outcrop. To test this, wells were drilled during the nineties by the Dominion Government at Victoria on the Saskatchewan, at Athabaska Landing, and

at the mouth of the Pelican river. In the first two wells the Dakota sandstone was not reached, whilst in the last it was reached at a depth of 750 ft. About 87 ft. of the sandstone was penetrated and found to contain maltha or heavy, tarry petroleum.

Prospecting for gas has been more successful. The boring at the mouth of the Pelican river proved the presence of a great reservoir of gas in the Dakota sandstones, and heavy flows were struck at 820 and 837 ft. In southern Alberta, also, gas is found in paying quantities. A good field exists at Medicine Hat, and flows have been obtained at several different points west of that city. At Bow Island, 8 wells sunk up to the date of February 21, 1912, showed flows varying between 1,250,000 to 29,000,000 cubic ft. per day. The pressure in these wells is 800 lb. per square inch. The wells have a depth of 1,890 to 1,930 ft., and gas is struck at three or four levels in the sandstone of the last 40 ft., and this is believed to be the Dakota sandstone.

Thus, whilst the presence of oil in commercial quantities remains to be proved, boring operations have demonstrated beyond doubt the existence of large reservoirs of natural gas, and it seems probable that further exploratory work throughout the wide area underlain by the Cretaceous rocks should lead to the discovery of other reservoirs. It is considered probable that the Devonian limestone is the source of the gas and petroleum products of northern Alberta, and that the porous Dakota sandstone forms the reservoir into which they have risen and in which they have been retained by the overlying shales. As the Devonian limestone and Dakota sandstone are of wide distribution, and probably underlie the western part of Manitoba and a great part of Saskatchewan and Alberta, the prospects for the discovery of other gasfields seem favourable. On account of the great thickness of sediments overlying these formations, however, the driller must be prepared to go to a considerable depth.

In a profusely illustrated memoir on the oilfields of Burma (*Mem. Geol. Surv. India*, 1912, **40**, Part I.) E. H. Pascoe gives an exhaustive account of the information available on this subject, including a bibliography. The memoir also includes a bibliography relating to oil occurrences in other parts of the Indian Empire. Works previously published by the Survey on the Burma oilfields are "The Occurrence of Petroleum in Burma and its Technical Exploitation," by F. Noetling (*Mem. Geol. Surv. India*, 1897, **27**, Part II.), and "The Geology of Parts of the Myingyan Magwe and Pakokku Districts, Burma," by G. E. Grimes (*Mem. Geol. Surv. India*, 1898, **28**, Part I.). A considerable amount of information has been accumulated since the issue of those publications, and Mr. Pascoe, who spent four field

seasons between 1905 and 1909 collecting notes on this subject, has brought the information up to date in his memoir. The memoir includes a chapter on the origin of petroleum, which is of special interest in view of the fact that certain workers have regarded the evidence provided by the oilfields of Burma as supporting the hypothesis that the petroleum there is of inorganic or deep-seated origin. Mr. Pascoe finds no evidence in the Burma fields to support the inorganic view, and he concludes that the oil is of organic origin, and probably formed from plant rather than from animal remains. He recounts instances of the association of coal and petroleum, and attributes to these a common origin, local conditions determining the nature of the change. "Where conditions were eminently favourable for the formation of coal, they apparently were not so for petroleum, since beds bearing thick seams of coal are apt to contain little or no petroleum; on the other hand, where conditions did not permit of more than thin layers and local patches of lignite or coal being formed, larger quantities of oil are liable to be found—one is tempted to say 'instead of coal.'" Mr. Pascoe also concludes that the oil has been formed *in situ*, *i.e.* in the beds in which it occurs, and that it does not owe its present position to "upward migration."

Silver Ore.—The Ontario Bureau of Mines (Toronto, 1913) has issued a fourth edition of W. G. Miller's monograph on *The Cobalt-nickel Arsenides and Silver Deposits of Temiskaming*. Some features have been treated more fully in this edition, underground work in the mines having furnished many details concerning the structural relations and the character of the veins. Advantage has been taken of this information to prepare several cross sections and other illustrations, which will add interest to the report.

The deposits dealt with in this monograph are in some respects unique. This area is not only the world's greatest producer of silver, but it controls the market for cobalt, has a large output of arsenic, and is among the three or four areas that have the largest output of nickel.

It is of interest to note that these deposits were discovered as recently as 1903, during the building of the Temiskaming and Northern Ontario Railway, which runs almost over the top of one of the most important veins. The Sudbury nickel deposits, ninety miles south-west of Cobalt, which are the most important in the world, were discovered much in the same way, during the construction of the Canadian Pacific Railway.

NOTICES OF RECENT LITERATURE

THE ROMAN AND THE BRITISH EMPIRES. Two Historical Studies by James Bryce. Pp. 138, Demy 8vo. (London: Oxford University Press, 1914.) Price 6*s.* net; post free, United Kingdom 6*s.* 4*d.*, abroad 6*s.* 5*d.*

Under this general title, Mr. James (now Viscount) Bryce re-issues two essays which were published some years ago in the volumes entitled *Studies in History and Jurisprudence*: "The Ancient Roman Empire and the British Empire in India," and "The Diffusion of Roman and English Law throughout the World." In this more accessible form, the topics dealt with will appeal to those making a special study of Imperial organisation. On the historical side, it is interesting to note, in the words of this high authority, that "it was really from internal maladies, from anæmia or atrophy, from the want of men and the want of money, perhaps also from the want of wisdom, rather than from the appearance of more formidable foes, that the Roman dominion perished in the West," and that "British power in India shows no similar sign of weakness" (p. 76). In his legal essay, Lord Bryce, referring to the progress of the world towards uniformity in law, expresses the view that neither Roman law nor English law is likely to overpower or absorb the other, but that fusion is possible "in the course of ages."

KING'S COLLEGE LECTURES ON COLONIAL PROBLEMS. Edited by F. J. C. Hearnshaw, M.A., LL.D. Pp. xiii + 252, Crown 8vo. (London: G. Bell & Sons, Ltd., 1913.) Price 4*s.* 6*d.* net; post free, United Kingdom 4*s.* 10*d.*, abroad 5*s.*

The series of lectures delivered at King's College during the summer term of the session 1912–13 dealt with the following subjects: The Colonies in International Law (Rev. T. J. Lawrence, LL.D.); Native Land and Labour in the South Seas (Sir Everard Im Thurn, K.C.M.G.); Problems of Australian Federation (Sir John Cockburn, K.C.M.G.); The Influence of Science on Empire (Sir Charles Lucas, K.C.B.); The Colonial Reformers of 1830 (Prof. H. E. Egerton); and Problem of an Imperial Executive (Mr. Sidney Low). Mr. Harcourt, Secretary of State for the Colonies, supplies a Prefatory Note; whilst, in the Introduction to the series, it is stated that the lectures are to be followed up during the coming session, and that Mr. Sidney Low has been appointed lecturer in Imperial and Colonial History for the year. The problems dealt with in the present volume are for the most part problems of the past, but Mr. Sidney Low boldly faces some prob-

lems of the future, from the point of view of a publicist, and deals with these in an interesting manner.

Such a scheme of Imperial studies is obviously of public utility; but it would gain greatly in force if, in place of detached problems—more or less of academic interest—each series in the future were directed to the elucidation of some central problem of Imperial Organisation, such as might be supposed to claim the attention of an Imperial Council.

GUIDE TO THE PRINCIPAL PARLIAMENTARY PAPERS RELATING TO THE DOMINIONS, 1812–1911. Prepared by Margaret I. Adam, J. Ewing, and J. Munro. Pp. viii + 190, Med. 8vo. (Edinburgh: Oliver & Boyd, 1913.) Price 3*s.* 6*d.*; post free, United Kingdom 3*s.* 10*d.*, abroad 4*s.*

This guide will be of great value to any one who may have occasion to study the history of the development of any of the over-seas Dominions.

The contents are arranged geographically in the order Canada, Newfoundland, Australia, New Zealand, South Africa, followed by two sections giving the titles of papers dealing with Emigration and Colonisation, and finally of miscellaneous papers relating generally to the Dominions. For each paper the session, volume, number of paper, and the numbers of the first and last pages are given, followed by the title of the paper and a brief statement of its contents. In the preface to the volume there is a very useful note by Mr. Austin Smyth, on the origin and history of Parliamentary Papers. The volume is provided with a good index.

THE TEACHING OF INDIAN HISTORY. By William Holden Hutton, B.D. Pp. 29, Demy 8vo. (Oxford: at the Clarendon Press, 1914.) Price 1*s.*; post free, United Kingdom and abroad, 1*s.* 1*d.*

This is Mr. Hutton's inaugural lecture as Reader in Indian History in the University of Oxford. Beginning with an appreciatory reference to his predecessor, Mr. Sidney Owen, the lecturer quoted Lord Acton's declaration "that if we lower our standard in history, we cannot uphold it in Church or State," as an ideal which should be constantly before the eyes of historical students, and as a warning never more needed than in the study of British India. The lecturer went on to refer to some of the more important advances in our knowledge of Indian history made in recent years, and to indicate some of the subjects on which ample material awaits research by students who propose to specialise in this subject.

Mr. Hutton concluded with an eloquent appeal for better provision for the study of Indian subjects at the University, and particularly for Indian history (the present

Readership is confined to the history of India since the British occupation), urging that such studies would do much to create a race of British officials understanding the Indian character, and therefore able to deal with the difficult problems which the government of India will present in the near future.

INDIEN. Handbuch für Reisende. Von Karl Bædeker. Mit 22 Karten, 33 Plänen, und 8 Grundrissen. Pp. lxxiv + 358, Small 8vo. (Leipzig: Karl Bædeker, 1914.) Price, M. 20; post free, United Kingdom 20*s.* 4*d.*, abroad 20*s.* 6*d.*

This compact handbook, primarily intended for the German traveller, with little leisure to linger by the way, covers the principal routes followed by tourists in India and Ceylon, and flying visits to Burma, the Malay Peninsula, Siam, and Java. It contains also the usual introductory matter for the aid of travellers, a description of the voyage out, and a general survey of India. The spelling of Indian place-names is based on the *Imperial Gazetteer of India*, with some German equivalents in pronunciation. The maps are excellent.

The practical and up-to-date information contained in this guide is admirably arranged, and should be serviceable to travellers making a voyage round the world.

EGYPT IN TRANSITION. By Sidney Low. With an Introduction by the Earl of Cromer, G.C.B. Pp. xxiv + 290, Demy 8vo. With portraits. (London: Smith, Elder & Co., 1914.) Price 7*s.* 6*d.* net; post free, United Kingdom 7*s.* 10*d.*, abroad 8*s.* 2*d.*

We do not know of any book on modern Egypt since Milner's classic *England in Egypt* (1894) which conveys, in popular form, a more vivid and accurate impression of the regeneration of the Nile Valley than Mr. Sidney Low's contribution to the subject. The period of transition covered in his survey is said to be "between the reconquest of the Sudan by Lord Kitchener and his return to Cairo as British Agent and Consul-General"; and in this survey the greater—as well as the more interesting—part of the volume is devoted to the Sudan under the Anglo-Egyptian Condominium. The title requires this explanation. On the main causes that have contributed to the remarkable progress achieved in the Sudan under the Sirdar and Governor-General, Sir Reginald Wingate, the introduction by Lord Cromer supplies an interesting commentary.

The Egypt of Mr. Sidney Low is essentially the Egypt so well known to us in the series of annual reports by Lord Cromer: it reflects the correct official attitude of the Protectoral Power towards Egypt, regarded as a province of the Ottoman Empire; and, like Lord Cromer himself,

our author favours the adoption of steps towards the abolition or modification of the Capitulations, which do not hamper the administration of the Sudan. The political and economical situation in the Nile Valley is clearly outlined, and full justice is done to the Civil Services that have been created and so efficiently maintained. The native element, too, is dealt with in a sympathetic and judicious spirit, evincing a mastery of facts which the writer has personally investigated on the spot, and not taken at second-hand. Mr. Low writes with judgment, reserve, and with that immediate penetration to the heart of a problem which comes from intensive study and wide experience. His descriptive passages, both of scenery and native life, are not the least admirable feature of a remarkable book; and even those who are interested in Egypt only as a winter resort will find much to attract them.

A REPORT ON THE LAND SETTLEMENT OF THE GEZIRA (MESELLEMIA DISTRICT). By H. St. G. Peacock. Pp. 68, Imper. 8vo. (London: Sifton Praed & Co., 1913.) Price 3*s.*; post free, United Kingdom 3*s.* 4*d.*, abroad 3*s.* 5*d.*

The Gezira, or island, is the triangular tract of country formed by the Blue Nile and White Nile in the Anglo-Egyptian Sudan. The area is of special importance at the present time, since, as already mentioned in this BULLETIN (1913, 11, 189), the irrigation of a portion of it is being undertaken, with a view to the more extended cultivation of cotton, cereals, and other crops.

The present report was written for the most part in 1910, and is divided into three main portions. The first of these gives a brief history of the Gezira, from the time when it is believed to have been part of a Christian kingdom down to April 1898, when the tribes of the Gezira announced their willingness to submit to Lord Kitchener's army, which had then advanced as far as Atbara. The second portion explains that the object of the Land Settlement was to form a Register of Title as a preliminary to the development of the country by railways and irrigation. It gives a detailed account of how the work was done, describes the progress made in each of the years 1906 to 1910, and mentions some of the curious difficulties encountered in determining the ownership of lands. The last section describes the condition of the country in 1910 as regards population, communications, rainfall, capital and credit, and other similar matters.

The report is provided with a number of good maps and contains a large number of pictures of typical scenes met with during the work of registration. In view of the work of economic development now in progress the Gezira is likely to attract a good deal of attention, and

this report will be of great value as affording useful and accurate information on many points of economic interest.

BRITISH SOMALILAND. By R. E. Drake-Brockman, M.R.C.S., L.R.C.P. Pp. x + 334, 8vo. (London: Hurst & Blackett, Ltd., 1912.) Price 12*s.* 6*d.* net; post free, United Kingdom 12*s.* 11*d.*, abroad 13*s.* 3*d.*

MY SOMALI BOOK: A RECORD OF TWO SHOOTING TRIPS. By Captain A. H. E. Mosse, F.Z.S., Indian Army. With an Introduction by Col. H. G. C. Swayne, R.E., F.Z.S. Pp. xxvi + 314, 8vo. (London: Sampson Low, Marston & Co., Ltd., 1913.) Price 12*s.* 6*d.* net; post free, United Kingdom 12*s.* 11*d.*, abroad 13*s.* 4*d.*

Though Somaliland is a depressing place from a political, and perhaps also from a military point of view, it possesses great attractions for the naturalist, whether he specialises on the fauna or the flora. Dr. Drake-Brockman also shows that its history is by no means devoid of interesting problems; but perhaps the most remarkable feature of his book is the amount of space devoted in one way or another to the economic plant and animal resources of the country. He has contributed in no small degree to our knowledge of these subjects, and in another portion of this BULLETIN (p. 11) a report on the gums, gum-resins, and resins of Somaliland is published, dealing with material collected by him.

Matters of more general interest in regard to Somaliland are, however, not neglected by the author, and the chapters describing the coast towns and those dealing with the "Mad Mullah," the outcast tribes, the Somali character, to mention a few of them, are full of interesting matter, as is to be expected from so keen an observer.

A useful sketch-map of the country and numerous excellent illustrations are provided.

As is indicated in the sub-title of his book, Captain Mosse is mainly concerned with Somaliland as a big-game country, and of his seventeen chapters twelve are occupied with racily written accounts of his experiences in two shooting expeditions undertaken in 1907 and 1909, while the interior of British Somaliland was still open. It is interesting to note that he agrees with Dr. Drake-Brockman that the Somalis' principal faults are vanity and avarice, and that apart from these weaknesses they have many estimable qualities.

A long chapter is devoted to the question of protective colouration in animals, the author taking the view that, "while perhaps the majority of the larger mammals, at the present day and under existing conditions, can no longer be considered to benefit from the concealing effect

of their colouration; yet that fact is not in itself any reason for rejecting the theory that the necessity for concealment has been in all probability the most important factor in establishing the existing schemes of colouration amongst animals."

The last two chapters deal with the equipment and arrangements for big-game shooting expeditions and with the factors which determine the value of rifles to be used in such expeditions.

The book is embellished with a number of good reproductions of photographs and with many pen-and-ink sketches: the photographs being by the author and the sketches by Lieut. Haskard, R.A.

PIONEERS IN SOUTH AFRICA. By Sir Harry Johnston, G.C.M.G., K.C.B. With eight coloured illustrations by Wal Paget. *Pioneers of Empire Series.* Pp. vii + 316, 8vo. (London: Blackie & Son, 1914.) Price 6*s.*; post free, United Kingdom 6*s.* 5*d.*, abroad 6*s.* 9*d.*

The task which Sir Harry Johnston has accepted, in the production of a series of readable books dealing with pioneer work and adventure in the discovery and opening up of countries of the British Empire, is admirably performed in the volume for South Africa. Both in his historical retrospects and physical descriptions the author displays a mastery of detail on a subject he has made his own, in the development of Africa; and the reader is presented with a survey that will live in his memory, aided as this is by admirable illustrations in colour and in black-and-white. His excursions into botany and zoology might perhaps have been shorter, and one is somewhat surprised to find Livingstone referred to as "a martyr" (p. v); but, with these slight reserves, we have no further comment to make on a work which cannot fail to add to the popularity of the series, save to note the absence of an index.

A HISTORICAL GEOGRAPHY OF THE BRITISH COLONIES. By Sir C. P. Lucas, K.C.B., K.C.M.G. Vol. IV.: South Africa. *New Edition.* Part I., History to 1895. Pp. viii + 331. Part III., Geographical, revised by A. Berriedale Keith, D.C.L. Pp. iv + 332. Crown 8vo. (Oxford: Clarendon Press, 1913.) Price 6*s.* 6*d.* each; post free, United Kingdom 6*s.* 10*d.*, abroad 7*s.*

The immense advances and profound changes in the development and reconstruction of the British Colonies in South Africa have necessitated the recasting and comprehensive revision of Vol. IV. of this series, dealing with South and East Africa, whilst the emergence of the Union of South Africa, no less than the progress and advance in status of the other self-governing Dominions, renders the general title of the series subject to qualification at the

present day. The new edition of Vol. IV. is now issued in two parts, as given above; and Sir Charles Lucas has in preparation a further volume containing the history of South Africa subsequent to 1895, including the War. The volume on Central and East Africa (VII.) will be published separately. The issue of these two new volumes, and the promise of a third by the editor of the series, will be cordially welcomed by a wide circle of students and readers to whom the work is indispensable as a source of reference. But, whilst the historical section is richly illustrated by a new and practical series of sketch-maps by Mr. B. V. Darbishire, only one such map is provided for the geographical survey in the new edition.

A HISTORICAL GEOGRAPHY OF THE BRITISH COLONIES. By Sir C. P. Lucas, K.C.B., K.C.M.G. Vol. III. West Africa. *Third Edition*, revised to the end of 1912 by A. Berriedale Keith, D.C.L. Pp. 427, Crown 8vo. (Oxford: Clarendon Press, 1913.) Price 8*s.* 6*d.*; post free, United Kingdom 8*s.* 10*d.*, abroad 9*s.* 1*d.*

Fourteen years have elapsed since the preparation for press of the second edition of this volume, in the valuable series to which it belongs; and, during recent years, progress in Colonial development has been so marked in West Africa, that a new edition was urgently required. The work of revision and enlargement has been carried out by Dr. Berriedale Keith, author of *Responsible Government in the Dominions* (see this BULLETIN, 1912, **10**, 515), and new sketch-maps by Mr. B. V. Darbishire replace the coloured maps of the earlier editions. Two new chapters on West Africa in the Twentieth Century deal with the progress made in administrative control and with the improvements in trade and health conditions, in the opening up of these countries to European commerce and settlement.

THE SULTANATE OF BORNU. Translated from the German of Dr. A. Schultze. With additions and appendices. By P. Askell Benton, B.A., F.R.G.S. Pp. 401, Small 8vo. (London: Humphrey Milford, Oxford University Press, 1913). Price 7*s.* 6*d.* net; post free, United Kingdom 7*s.* 10*d.*, abroad 7*s.* 11*d.*

The translation into English of Dr. Schultze's monograph—the first of its kind—on this ancient Sultanate of the Central Sudan was well worth undertaking, in view of the somewhat scattered literature on the subject and of the importance of this region—or the greater part of it—under the recently created Governor-Generalship of Nigeria; and, although Mr. Benton expressly confesses his ignorance of the German language, the result, with such assistance as he was able to enlist, is eminently satisfactory. We are presented with a very readable—and, so far as we have tested

it, accurate—account of the physical conditions of this interesting inland drainage-area and of its ancient history, of its opening up to the policy of Europe by the travels of many distinguished British and German explorers, and of the conditions and commercial prospects now existing. There are no less than 21 appendices, occupying nearly one-half of the book, some of which seem redundant; and the two maps are printed from the same plates as those for the German edition.

THE NEW WORLD OF THE SOUTH. The Romance of Australian History. By W. H. Fitchett, B.A., LL.D. Pp. viii+428, Crown 8vo. (London: Smith, Elder & Co., 1913.) Price 6*s.*; post free, United Kingdom 6*s.* 4*d.*, abroad 6*s.* 6*d.*

Dr. Fitchett's second volume, under the same title as the volume previously noticed (see this BULLETIN, 1913, **11**, 372), deals with romantic incidents in Australian history grouped under headings which indicate their historical connection with the development of Australia, up to the birth of the Commonwealth. But, in this supplementary volume, there is little continuity of treatment, except under geographical discovery, until Book IV. (p. 385) is reached, when the political evolution of the Federating Colonies is briefly outlined. The bulk of the book is frankly devoted to stories of the second generation of bushrangers, whose stirring adventures had little effect on the making of history. As in the previous volume, the treatment of geographical exploration is to be specially commended.

THE BARBADOS HANDBOOK, 1914. By E. Goulburn Sinckler. Pp. xii+233, Demy 8vo. (London: Duckworth & Co., 1914.) Price 2*s.* 6*d.* net; post free, United Kingdom 2*s.* 10*d.*, abroad 3*s.* 2*d.*

Reference to this excellent Handbook has already been made in this BULLETIN (1912, **10**, 343). The present volume forms the third edition, and covers essentially the same ground as its predecessors, but the opportunity has been taken of extending considerably the section devoted to the history of Barbados, which is now brought down to current times. This feature is of no small historical value, since Sir R. Schomburgh's *History of Barbados* deals only with the period down to 1846. It will be sufficient to add that the excellent printing, illustrations, and appearance of the former editions are fully maintained.

ELEMENTARY TROPICAL AGRICULTURE. By W. H. Johnson, F.L.S. Pp. xi+150, Demy 8vo. (London: Crosby, Lockwood & Son, 1913.) Price 3*s.* 6*d.* net; post free, United Kingdom 3*s.* 10*d.*, abroad 3*s.* 11*d.*

In his preface to this volume, the author explains that the book is intended for use in connection with the study

of the principles of agriculture in West African schools, and that he hopes it will prove useful for a similar purpose in other tropical countries.

From the outset Mr. Johnson assumes that the school will have a garden and that agriculture can only be taught with the aid of experiments carried on by the students themselves. With this primary condition constantly in mind, he discusses in simple language the formation and composition of soil and the principles which underlie modern methods of utilising soil to the best advantage. He then goes on to the various parts of a plant, dealing in the same way with their structure and functions, and concludes the first portion of the book with two useful chapters on fungoid diseases and insect pests. The second portion consists of three chapters dealing with the formation and care of the school garden, including suggestions as to the crops that should be grown in it. Throughout the book simple experiments, well designed to illustrate the points which it is sought to demonstrate, are suggested, and the plants and materials employed for the experiments are always such as are readily obtainable in West Africa, and indeed throughout the greater part of the tropics. Numerous illustrations are provided, mostly original line drawings prepared by the author's colleague, Mr. Peacock, lately Entomologist in the Department of Agriculture of Southern Nigeria.

The book is clearly intended for native students working under a teacher, who may be assumed to be familiar with the weak points of local native farming. For that reason, no doubt, no special emphasis is laid on the necessity for a complete change in certain practices which are almost characteristic of native farming throughout the tropics. It is a nice point whether it is better to condemn bad practice to a student or to teach him sound principles and leave him to discover and avoid bad practice for himself. The author is probably quite correct in thinking the latter the better method.

Mr. Johnson points out in his preface that the best method of removing the antipathy exhibited by educated West African natives to agriculture is to make the latter a specific subject in the native school course. This is a good suggestion, and in providing this serviceable text-book the author has made it distinctly easier to put his suggestion into practice.

THE DISEASES OF TROPICAL PLANTS. By Melville Thurston Cook, Ph. D. Pp. xi + 317, Demy 8vo. (London: Macmillan & Co., 1913.) Price 8*s.* 6*d.* net; post free, United Kingdom 8*s.* 11*d.*, abroad 9*s.* 3*d.*

In this volume the author has attempted the very difficult task of preparing a handbook on the fungal diseases

affecting the economic plants of the tropics. The immense number of such diseases, the lacunæ in our information regarding a large proportion of them, and the varying character of the problems concerned in different parts of the tropics, render the work of special magnitude, to which justice cannot be done in some three hundred pages, many of which are concerned with preliminary or accessory matter. The author, however, has provided a useful introduction to the subject. The book is intended primarily for planters, and the arrangement has been planned accordingly. Introductory chapters deal with the nature and symptoms of plant diseases, the structure and functions of plants, and give a useful classification of fungi; while special sections deal with practical questions of prevention and control, the preparation of fungicides, and the manipulation of spraying apparatus.

The body of the book is concerned with the description of specific diseases. The treatment is non-technical rather than "popular," but the planter has not been spared in the use of scientific names, the careful record of which renders the book of value to students, who will also find the bibliography of important papers a useful introduction to the extensive literature of the subject. Reference must be made to the excellent character of the great majority of the illustrations, which are in somewhat sharp contrast with the diagrams provided in the preliminary chapters.

MILDEWS, RUSTS, AND SMUTS. By George Massee, assisted by Ivy Massee. Pp. 229, Demy 8vo. (London: Dulau & Co., 1913.) Price *7s. 6d.* net; post free, United Kingdom *7s. 10d.*, abroad *8s.*

In this book, which comprises a synopsis of Peronosporaceæ, Erysiphaceæ, Uredinaceæ, and Ustilaginaceæ, the authors have kept two objects in view, viz. to afford an account of modern views in regard to the important groups mentioned; and to facilitate the identification of fungi included in them. Both these objects would appear to have been accomplished, and the volume should be of considerable assistance to the increasing number of students of economic mycology. The plan of the work is on the usual lines, which are of proved utility. A general account of the family is succeeded by brief notes on the genera, which are subsequently differentiated by means of a "key." The species are then described, details of synonymy and information regarding host-plants being provided. Species other than those already found in this country are included—a desirable feature in view of the frequency of new records. The book concludes with an index of genera and species, and a list of host-plants. There is a coloured frontispiece, and a number of line drawings are arranged in four plates. The binding and format of the book are on

thoroughly practical lines, a matter of importance in a work of reference.

PLANTING IN UGANDA: COFFEE, PARA RUBBER, COCOA. By E. Brown, F.L.S., and H. H. Hunter, LL.D. With contributions by Professor Dunstan, C.M.G., etc., and Mr. George Massee, F.L.S. Pp. xvi + 176, Demy 8vo. (London: Longmans, Green & Co.; Dublin: The Talbot Press, 1913.) Price 10*s.* 6*d.*; post free, United Kingdom 10*s.* 10*d.*, abroad 11*s.* 2*d.*

It has been pointed out already in this BULLETIN that British planters are less fortunate than many of their foreign competitors, in the fact that comparatively few books on tropical agriculture and tropical crops have been published in English. The books in English that have appeared dealing with these subjects have usually been compiled on the Continental plan of devoting a book to a single crop, such as rubber, cocoa, coconuts, etc., or to a group of closely allied products, as in the case of Mr. Ridley's book on *Spices*. Mr. Brown and Dr. Hunter have adopted a new plan, viz. that of dealing with a few crops in a particular area. There is much to be said for this from the planter's point of view, since only in this way can the influence of local peculiarities on particular crops be adequately discussed, within a reasonable space.

This novel feature of the book now under notice is probably responsible for the rather unusual mode adopted in discussing the three crops considered. The first chapter is quite general and deals with the physical features of the country; the next is devoted to the history of the three crops in Uganda; and the remaining chapters deal in logical sequence with such subjects as the choice of land for plantations, nurseries, laying out plantations, clearing and planting, upkeep, factory and machinery, organisation of estates, etc., the novel feature being that at each stage in this transition the three crops are discussed seriatim in the same or subsequent chapters. This plan makes it a little difficult to follow each crop through all its stages, but it has certain practical advantages from the planters' point of view, and, after all, that should be the main consideration in a book of this kind. Mr. Massee contributes a useful chapter on the fungoid diseases of cocoa, coffee, and Para rubber, and Prof. Dunstan provides an introduction in which he directs attention to the useful work in tropical agriculture done in Uganda by the small establishment of scientific officers, which has recently become the Agricultural Department of the Protectorate. The book is very well produced, and contains a large number of excellent illustrations, mostly reproductions from photographs. It should be of great value to the small but enterprising body of European planters in Uganda.

THE BANANA: ITS CULTIVATION, DISTRIBUTION, AND COMMERCIAL USES. By William Fawcett, B.Sc. (Lond.), F.L.S., With an Introduction by Sir Daniel Morris, K.C.M.G., D.Sc., D.C.L., F.L.S. Pp. xi + 287, Demy 8vo. (London: Duckworth & Co., 1913.) Price 7*s.* 6*d.* net; post free, United Kingdom 7*s.* 10*d.*, abroad 8*s.*

In the introduction to this work, Sir Daniel Morris draws attention to the magnitude of the banana industry, and refers to the fact that its rapid and enormous growth was due to the discovery of the means of transporting the fruit successfully in cold storage.

The book gives a complete account of the banana, including a description of the plant, the methods of planting, cultivating and harvesting the crop, the pests and diseases by which it is liable to be attacked, the development of the banana trade, and the by-products of the industry.

The chapters on the general cultivation of the plant deal with the methods employed in Jamaica, where the author has been in close touch with the industry for many years. In later chapters, however, reference is made to the practice of other countries, viz. India and Ceylon, the Malay Archipelago, the Philippine Islands, Australia, Polynesia, Africa, South America, Central America and the United States, and the West Indies and Bermuda. It is pointed out that the bananas of Jamaica and Central America are derived from cultivated varieties of *Musa sapientum*; those of the Canary Isles from *M. Cavendishii*, and those of the Malay region from *M. acuminata* and *M. sapientum*. Plantains are derived from *M. paradisiaca*; they are not exported to the United Kingdom, and only in small quantities to the United States.

The costs of cultivation and the returns which may be expected are dealt with, and the prospects are discussed of those undertaking banana planting for the first time. An account is given of the production of Manila hemp and other fibres derived from various species of Musa. A short chapter is devoted to species of Ravenna, Strelitzia, and Heliconia, which are allied to the banana plant, and another gives a brief description of the numerous species of Musa. Information is supplied on the preparation of dried bananas and banana flour, and the manufacture of wine, whisky, and alcohol from the fruit, and, in a short appendix, a series of recipes is given for cooking bananas. The commercial aspect of the industry is well treated, and interesting details are given of the methods of transporting the fruit both by land and sea.

The book is written in a clear and interesting manner, contains some excellent illustrations, and can be recommended as a valuable treatise on every phase of the banana industry.

THE TEXTILE FIBRES: THEIR PHYSICAL, MICROSCOPICAL, AND CHEMICAL PROPERTIES. By J. Merritt Matthews, Ph.D. *Third Edition.* Pp. xi + 630, with 141 figs., Demy 8vo. (New York: John Wiley & Sons; London: Chapman & Hall, Ltd., 1913.) Price 17*s.* net; post free, United Kingdom 17*s.* 6*d.*, abroad 18*s.*

This valuable work, which has now reached its third edition, gives an account of the various fibres employed in the textile industries. The word "textile" is used in its widest significance, the fibres dealt with including not only the textile fibres proper, but also those employed for cordage manufacture, brush-making, and upholstery. The greater part of the book is devoted to an account of the physical and microscopical characters and the chemical composition and reactions of the fibres, but considerable space is also allotted to the bearing of these properties on the industrial utilisation of the products. Distinctive tests are recorded for the recognition and identification of the various fibres, and schemes of analysis are provided for their detection and estimation, both in mixtures and also in yarns and fabrics. The work is well illustrated, and contains a useful bibliography.

The new edition has been thoroughly revised and brought up to date, and contains many important additions. There is no doubt that the various improvements will render it of increased utility both to those practically engaged in the textile industries and also to students and others interested in the subjects with which it deals.

DIE JUTE: IHRE INDUSTRIE UND VOLKWIRTSCHAFTLICHE BEDEUTUNG. By Richard Wolff. Pp. 147, Med. 8vo. (Berlin: Franz Siemenroth, 1913.) Price M. 6; post free, United Kingdom 6*s.* 4*d.*, abroad 6*s.* 6*d.*

This work deals mainly with the manufacturing industries which depend on jute as their raw material. A short account is given of the production of the fibre in India and other countries, and of the attempts to discover suitable substitutes for it, both natural and artificial. In this connection it is unfortunate that the author refers to China jute as a true jute, instead of a substitute, thus leading the reader to suppose that it is derived from a species of Corchorus, whereas actually it is the fibre of *Abutilon Avicennæ*. The trade in raw jute, and the fluctuations in price of the fibre and of yarns and fabrics manufactured from it, are discussed, and are illustrated by several statistical tables and diagrams. The remaining chapters are devoted to an account of the jute-manufacturing industries of India, the various European countries, Brazil, Japan, and the United States of America. The book is a useful compilation and a valuable exposition of the economic importance of jute.

Coconuts: the Consols of the East. *By H. Hamel* Smith and F. A. G. Pape. 2nd Ed. With forewords to both editions by Sir W. H. Lever, Bart. Pp. lxviii + 644, Crown 8vo. (London: John Bale, Sons, & Danielsson, Ltd., 1914.) Price 12*s.* 6*d.* net; post free, United Kingdom 12*s.* 11*d.*, abroad 13*s.* 3*d.*

Reference to the first edition of this useful work was made in this Bulletin (1913, **11**, 522). The book has now been revised and enlarged. The additions include an account of the costs of manufacturing copra, and sections on (1) a fungus parasitic on the larvæ of coconut beetles, (2) the breeding of horses on coconut estates, (3) the manufacture of butter substitutes from coconut oil, (4) coconut cultivation in the Solomon Islands and in Fiji, and (5) the use of dynamite for breaking up hard soils and removing rocks and tree stumps and for other purposes in the establishment of coconut plantations. The section on the manufacture of coir has been rewritten and brought up to date.

Evaporation in the Cane and the Beet Sugar Factory. A Theoretical and Practical Treatise. By Edward Koppeschaar, formerly Technical Manager of the Vierverlaten Sugar Factory, Holland. Pp. viii + 116, Roy. 8vo. (London: Norman Rodger, 1914.) Price 7*s.* 6*d.* net; post free, United Kingdom 7*s.* 10*d.*, abroad 8*s.*

This work deals with the principles of evaporation, particularly in relation to the requirements of the sugar industry, and also gives an account of the various forms of evaporating plant, the methods of control, and the different calculations required in connection with the processes of evaporation involved in sugar manufacture.

The book is well provided with plates, plans, and diagrams, and contains some useful tables. It will doubtless prove of considerable service to factory managers, engineers, and others employed in sugar mills.

A Course of Practical Work in the Chemistry of the Garden. By D. R. Edwardes-Ker. Pp. 40, Crown 8vo. (London: John Murray, 1914.) Price 1*s.* 6*d.* net; post free, United Kingdon and abroad, 1*s.* 8*d.*

This book describes a number of simple experiments for the detection of the principal constituents of plants, soils, and manures, and concludes with a chapter on the preparation of sprays and washes. Exception may be taken to a few statements in the book, such as the one which ascribes *astringent* properties to quassia, and another which refers to "lime sulphur" as a *new* fungicidal wash.

The experiments are well selected with a view to affording an insight into horticultural chemistry, and the book will be useful both to teachers and students of gardening and rural science.

THE CHEMISTRY OF CATTLE FEEDING AND DAIRYING. By J. Alan Murray, B.Sc. (Edin.), Lecturer in Agricultural Chemistry at University College, Reading. Pp. xii + 343, Crown 8vo. (London: Longmans, Green & Co., 1914.) Price 6*s.* net; post free, United Kingdom 6*s.* 4*d.*, abroad 6*s.* 8*d.*

In Parts II. to IV. of this work, which should prove very valuable to students of agricultural chemistry, a critical study is made of the subjects of cattle feeding and milk production, and of the value of different feeding stuffs. These subjects are discussed by means of calculations based on the composition of the different foods, their digestibility, and the quantities of heat and work they can produce when oxidised in the animal body, and on the increase in body weight of a growing or fattening animal, and on the yield of milk. Part I., which extends to p. 97, deals with the constituents of plants and animals, and is intended to be used for reference, as the information it gives is in a very condensed form.

This work shows that one problem now calling for solution is as to how the proteins of the food are converted into the tissues and materials of the animal body, and the value of different proteins for this purpose. Formerly, in comparing foods, it had to be assumed that one protein was as good as another, but now the difference in their natures is attracting attention; thus mice died of nitrogen starvation when zein, a protein of maize, was the only nitrogenous constituent of their food. It is thought that any single vegetable protein is inadequate, but that by supplying a mixture of foods those nitrogenous groups necessary for the animal will be provided.

BRITISH AND COLONIAL DAIRYING FOR SCHOOL, FARM, AND FACTORY. By G. Sutherland Thomson, F.R.S.E., with an Introduction by J. A. Ruddick, Dairy Commissioner for Canada. Pp. xi+464, Demy 8vo. (London: Crosby, Lockwood & Son, 1913.) Price 5*s.*; post free, United Kingdom 5*s.* 5*d.*, abroad 5*s.* 10*d.*

This manual of dairying in all its branches affords striking evidence of the high standard of excellence now required in this important branch of agriculture.

In the first chapter the author discusses the milk supply, and emphasises an important point, no doubt often forgotten, viz. that the contamination of milk, and therefore the spread of disease, can as often be traced to the carelessness of milk consumers as to unhealthy cows. Householders, he contends, should be made to realise their own responsibilities in this matter, which would tend to reduce mortality from tubercular disease communicable through the milk supply.

There is a long chapter on butter production, in the

course of which the author refers to the gradual decrease of butter exports from the Dominions to the United Kingdom during recent years, and its effect on the home trade, which has been to raise the price of butter without any corresponding improvement in quality, with the net result of stimulating the sale of margarine. This product now comes into active competition with butter, especially the lower grades; but Mr. Thomson considers that the best brands of margarine will soon be on a level with first-class butter.

An important section in the book is that dealing with the rearing and breeding of stock. In that treating of the development of the dairying industry some striking figures relating to the expansion of the industry, in the colonies and elsewhere, are given. In Australia, for example, the output of butter has more than doubled in the past ten years.

The book is well illustrated and well produced, and is written in a style which will appeal to those practically concerned in the dairy industry both at home and in the overseas Dominions.

A PILGRIMAGE OF BRITISH FARMING, 1910–12. By A. D. Hall, M.A., F.R.S. Reprinted by permission from *The Times*. Pp. xiii+452, 8vo. (London: John Murray, 1913.) Price 5*s*. net; post free, United Kingdom 5*s*. 4*d*., abroad 5*s*. 7*d*.

In the latter part of the eighteenth century, Arthur Young, a prolific writer on agricultural subjects, whose labours were of the greatest value to British agriculture, published his *Farmer's Tours in England, Wales, and Ireland*. In the introduction to one of these he writes, "Practices that are found highly advantageous in one district are totally unknown in another, although the soil, exposure, climate, etc., be exactly the same. The farmers in one place grow rich by methods which would enrich their brethren in another, but which remain quite unknown. Can it be thought useless to render all such local knowledge general? To let each cultivator see all the different methods that are practised upon such land as his own? . . . It is the design of this little register to spread useful knowledge of all sorts, to display to one part of the kingdom the practice of the other, to remark wherein such practice is hurtful, and wherein it is commendable."

No better account than this can be given of the present work, from which any one connected with the land is likely to obtain numerous valuable hints for improving his undertaking and increasing its profits, and which is likely to be far more stimulating in ideas that can be put into practice, than a more systematic work on agricultural subjects. The author's past work at Wye, and at the Rothamsted Experi-

mental Station, are a guarantee of the soundness of his views on all the different kinds of farming that he records.

His journeys extended from Cornwall to the Moray Firth, and from Essex to the West of Ireland, and he gives graphic accounts of the farming in the parts he visited, and of the economic position of the farmers. In his conclusions he says that the industry is at present sound and prosperous, and he thinks that further improvement lies in the direction of more co-operative effort amongst farmers in their purchases of materials and sales of produce, and more especially in the formation of groups of farmers raising money on the collective security of the whole body and lending it to members on the knowledge they possess of their character. He remarks that the ordinary farmer needs the more flexible habit of mind that comes with reading, and the susceptibility to ideas that comes from acquaintance with a different atmosphere than the one in which he ordinarily lives; he has little acquaintance with the methods by which other people attain the same ends, and regards his own style of farming as inevitable.

L'Industrie des Pèches sur la Côte Occidentale d'Afrique (Du Cap Blanc au Cap de Bonne-Espérance). Par A. Gruvel. Introduction de M. le Gouverneur général E. Roume. Pp. 193, with 24 plates and 44 figures in the text; Roy. 8vo. (Paris: Émile Larose, 1913.) Price 10 francs; post free, United Kingdom 8*s.* 4*d.*, abroad 8*s.* 8*d.*

Within recent years the appearance of monographs on the resources of West Africa has been a notable feature of the literature that is so rapidly accumulating around these important colonial possessions. The majority of such publications have been concerned with the development of agriculture and the exploitation of forest products; and a very useful purpose is served by the appearance of the present volume, which furnishes a reminder of the existence of other resources, the development of which would add not a little to the physical well-being of the native peoples concerned.

The full title of the book indicates that the fisheries dealt with are those of the geographical "west coast" of Africa, an area which includes the more restricted region commonly referred to under that name. On this coast fishing appears to be carried on for the most part by the natives, chiefly for supplying their personal needs, though in each of the colonies a certain proportion of the inhabitants make a living from fishery work, there being in some a considerable native trade in dried fish. In other colonies the industry is entirely in European or Asiatic hands. The author divides the colonies, irrespective of nationality, into two classes, viz. those producing a supply of prepared fish in excess of their needs, and therefore

permitting the export of a certain quantity; in this class are Dahomey, Angola, and the Union of South Africa; and, the remainder, including Gambia, Sierra Leone, Gold Coast, and Southern Nigeria, in which the demand for fish exceeds the supply.

The bulk of the volume is occupied with descriptions of the methods of production and preparation encountered in each colony; the writer describes in an entertaining manner the fishing grounds, the races of fishermen, their boats, nets, traps, and other fishing appliances, with the modes of use, as well as the fish met with, their preservation, and the native trade and local markets. It is interesting to note that a company of Breton fishermen, formed at Douarnenez, has recently commenced winter fishing operations off the coast of Mauritania and Senegal, the chief centre being Port Étienne. The results have been encouraging, and this example is being followed by other of their compatriots.

The remaining pages of the work are devoted chiefly to a list of the principal edible species of fish, crustaceans, and molluscs of the coast, and to general conclusions. In summing up the whole aspect of the fisheries, the author considers that the native fisheries are best developed in Senegal, Ivory Coast, Gold Coast, and Dahomey; and least so in Southern Nigeria and in French and Belgian Congo. In Togo, Kamerun, and in Spanish Guinea the industry is almost non-existent. Fishing in its European forms is being developed in Mauritania, and to a less extent in Senegal, whilst on the coasts of Angola the methods of fishing and preparation employed in the south of Portugal are being used with success. In the Union of South Africa, where the most modern methods are in vogue, the industry has attained great importance. Finally, the writer thinks that, with improved and more economical methods of fishing and preservation, the fisheries of the west coast of Africa can be made one of the most flourishing and productive industries of this region.

The volume is well illustrated with half-tone plates and text-figures, and has an excellent bibliography, but, unfortunately, lacks a general index.

MANURES AND FERTILISERS. By Homer J. Wheeler, Ph.D., D.Sc. Pp. xxi + 389, Crown 8vo. (New York: The Macmillan Co., 1913.) Price *7s.* net; post free, United Kingdom *7s. 5d.*, abroad *7s. 9d.*

This volume is written by an author who has been associated with the experimental side of his subject in the capacity of Director of the Agricultural Experiment Station of the Rhode Island State College, U.S.A., and with the manufacturing side as chemist to a manure factory in the United States. Methods of manufacture are not discussed

in full, but consideration is given to the composition and effects of practically all substances used as manure, the more important of these being considered in detail. Farmyard manure is fully dealt with, not only as regards its composition, storage, and use, but also as regards its organisms and the influence of these on soil fertility. The influence of lime on soil is adequately considered, and the chapters on the manurial effect of magnesium and sodium salts are of interest. The value of the book is enhanced by the frequent references to original work, particularly that carried out at the Rhode Island Agricultural Experiment Station.

The book is arranged in a manner very convenient for reference, and should prove of value both to agricultural students and to the practical farmer.

MINERAL DEPOSITS. By W. Lindgren. Pp. xv + 883. (London: McGraw-Hill Book Company, 1913.) Price 21*s.* net; post free, United Kingdom 21*s.* 6*d.*, abroad 22*s.* 3*d.*

Under the comprehensive title of *mineral deposits*, this book deals with ore deposits, and those other deposits from which useful minerals are obtained, but which have never been given a suitable name correlative with the name *ore deposits*. The designation "mineral deposits" is perhaps as much too wide for the purpose of this book as that of "ore deposits" is too narrow. To restrict its meaning in such a way as to make it suit the scope of his book, Mr. Lindgren defines "mineral deposits" as "geologic bodies which consist mainly of a single useful mineral, or which contain, throughout or in places, valuable minerals that can be profitably extracted." The study of these deposits has been actively carried on in recent years by workers in the United States, including the author himself, who is a well-known authority on this subject.

The manner of treatment adopted in this book is one to which readers of the literature of ore deposits have grown accustomed. It regards mode of origin as the most vital feature in the study of a mineral deposit, and is eminently suited to the requirements of the mining geologist, whose main purpose is, by determining the factors involved in the formation of deposits, to throw what light he can on the problem of their extension in depth, and to ascertain as far as possible the laws that govern their variation.

Lindgren makes physical and chemical factors predominant in his scheme of genetic classification. His two main groups are (I) deposits produced by mechanical processes of concentration (temperature and pressure moderate), and (II) deposits produced by chemical processes of concentration (temperature and pressure vary between wide limits). Group II comprises deposits formed (*a*) in bodies of surface waters, (*b*) in bodies of rocks, and (*c*) in

magmas by processes of differentiation. In the ultimate subdivisions an attempt is made to define the temperature and pressure conditions under which the deposits were formed. Lindgren's view is that "the genetic classification should ultimately determine the limits of ore deposition in each class by temperature and pressure. Each deposit should be considered as a problem in physical chemistry, and the solution of this problem, with the necessary geological data, will suffice to fix the mode of formation of the deposit."

The book has some of the defects that arise from a genetic treatment of the subject, and it is easy to select from its pages illustrations of these defects. For instance, the tin-ore deposits of Cornwall and Saxony get several pages, but those of the Malay Peninsula are dismissed in one small paragraph. Numerous other instances could be cited to show that the book is not intended as a guide to the relative economic importance of deposits, and that all important types of deposits have not received adequate attention by the author. In this connection the reader should remember a remark made in the preface, that "the general plan has been to select a few suitable examples to illustrate each genetic group of deposits."

It is thus for the advanced student and mining geologist that Mr. Lindgren has written his book, which is a valuable and trustworthy guide to the study of "mineral deposits." The book is excellently published, fairly well provided with illustrations and references to recent literature, and no mining geologist can afford to be without it.

NATURAL ROCK ASPHALTS AND BITUMENS. By Arthur Danby. Pp. viii + 244, Crown 8vo. (London: Constable and Co., 1913.) Price 8*s.* 6*d.* net; post free, United Kingdom 8*s.* 10*d.*, abroad 9*s.*

The increasing use of asphalt and bitumen in many branches of constructive work renders it desirable to have an up-to-date book dealing with current British practice, and this is the special claim made by the author for the present volume. The subject-matter includes the history, geology, natural occurrence, methods of working, physical properties, testing and uses of the various types of asphalt and bitumen.

It is unusual to find, in a technical work of this description, a chapter devoted to the early history of the subject and recounting the references to it in classical literature, and there is much to be said for this interesting innovation, so long as it is not overdone to the detriment of the technical matter.

The chapter on "Tests and Analyses" needs expert revision. Thus on p. 138 there is a statement to the effect that the mineral matter in asphalts is unchanged when

brought to a constant white heat and maintained at this temperature for a long time; this is incorrect as regards limestone, which is one of the most commonly occurring mineral substances in rock asphalt. After this treatment the residue is to be analysed, and, according to the author, the results obtained will render it possible to determine the place of origin of the bitumen. On p. 140, three methods are given for the estimation of petrolene, viz. (1) extraction with boiling alcohol, (2) steam distillation, (3) heating in a crucible at 250–260° C., until no further loss occurs; but it is not mentioned that these three methods do not give comparable results.

Two chapters are devoted to the technical utilisation of asphalt; the section on asphalt mastic work, written largely by Mr. H. W. Brant, dealing very fully with the subject.

In some respects the book is badly arranged. Thus, the chapter headed "Appearance and Physical Structure" contains matter relating to contract specifications. It is also to be regretted that, as a rule, the author does not give definite references to the authorities whom he quotes.

These defects can be easily remedied in a second edition, and they do not detract seriously from the value of the work to those practically engaged in producing or using asphalt.

THE MINING WORLD INDEX OF CURRENT LITERATURE. Vol. iii., first half-year 1913. By G. E. Sisley. Pp. xxvi + 158, Med. 8vo. (Chicago: The Mining World Company, 1913.) Price $1.50; post free, United Kingdom 6*s.* 10*d.*, abroad 7*s.*

This useful bibliography follows the same lines as the previous volumes (see this BULLETIN, 1913, **11**, 549), and covers a large variety of subjects connected with mining, including metals and metallic ores, non-metals, mines and mining, mills and milling, chemistry and assaying, metallurgy, power and machinery, and miscellaneous subjects. A new and useful feature is the addition of a list of the publications referred to in the index, including periodicals, books and transactions, bulletins, etc., of schools, societies, and Government departments.

THE SCIENCE OF BURNING LIQUID FUEL. By William Newton Best. Pp. 159, Med. 8vo. (London: E. & F. N. Spon, Ltd., 1913.) Price 9*s.*; post free, United Kingdom 9*s.* 4*d.*, abroad 9*s.* 7*d.*

This book covers the whole subject of the utilisation of mineral oil for the production of heat to be used for raising steam, for heating ovens and furnaces, and for other like purposes, but does not touch the use of oil in internal-combustion engines, though liquid fuel is perhaps burnt to greater advantage in this than in any other way at present in industrial use.

The author has been engaged, in the United States, in constructing and installing plant for burning oil fuel since 1887, and the information he gives is practical, and likely to be of great value in the installation and working of oil-fuel plants. After discussing the origin and production of liquid fuel, the atomisation of oil, oil-systems, and refractory materials for use in heating by burning oil, the author proceeds to describe oil-fuel equipment for marine, stationary, and locomotive boilers. Finally, ovens and furnaces for a great variety of purposes are dealt with, due attention being given in all cases to difficulties arising from inefficient combustion and other causes, and the means to be taken to avoid or remedy these troubles.

The book is printed in unusually large type, and is provided with numerous illustrations and scale drawings. The latter are clear and neatly arranged, but have been so much reduced in some cases that the explanatory lettering is almost illegible.

CYANAMID: MANUFACTURE, CHEMISTRY, AND USES. By Edward J. Pranke, B.Sc. Pp. vi + 119, Demy 8vo. (Easton, U.S.A.: The Chemical Publishing Co.; London: Williams & Norgate, 1913.) Price 5*s.*; post free, United Kingdom 5*s.* 4*d.*, abroad 5*s.* 5*d.*

During the past five years considerable activity has prevailed in the manufacture of nitrogenous manures from atmospheric nitrogen. One of the most important of these manures is calcium cyanamide, the output of which, during 1913, exceeded 250,000 tons. The widespread use of this product has led to the accumulation of much information regarding its chemical and agricultural properties, and the present volume is published as a review of the knowledge available at the present time.

Various terms are used to designate calcium cyanamide in commerce, and in a note on the nomenclature of the industry it is stated that the trade product is now called "nitrolim" in the United Kingdom, and usually Cyanamid (with the initial letter capitalised) in the United States, although the Department of Agriculture in the United States uses the name "calcium cyanamid." The author of this book restricts the term calcium cyanamide to the pure compound ($CaCN_2$) which is of theoretical interest only.

The author's chapter on the method of preparation of the manure hardly justifies the inclusion of the word "manufacture" in the title, as he describes the whole process, including the preparation of calcium carbide and pure nitrogen, and the packing of the final product, in about three pages.

After a useful summary of the chemical properties of pure calcium cyanamide, cyanamide, and dicyanamide, the

author gives analytical methods for the determination of nitrogen and of several organic compounds which may occur in the manure, but no mention is made of methods applicable to the estimation of the inorganic constituents present. Perhaps the best chapter in the book is the one dealing with the decomposition which "Cyanamid" undergoes in the soil. Here an impartial summary is given of the work carried out during recent years, particular attention being given to the important researches of Ulpiani and Kappen. This chapter, together with the one following, in which the toxicity of the manure is fully discussed, will probably prove the most interesting portions of the book to the agriculturist.

The short chapter on the agricultural use of the manure is disappointing; as although the author devotes two pages to a general discussion of the factors which may cause variations and errors in manurial trials, no adequate comparison is made of the efficiency of the manure, on typical soils, compared with such nitrogenous substances as ammonium sulphate, sodium nitrate or calcium nitrate. Other subjects, to which short chapters are devoted, include the storage and fire risks of "Cyanamid," its use as an ingredient in mixed manures, and the retention of "Cyanamid" nitrogen in the soil.

BOOKS RECEIVED

A VIEW OF THE ART OF COLONIZATION. By E. G. Wakefield. With an Introduction by J. Collier. Pp. xxiv + 510. (Oxford: Clarendon Press.) 5*s.* net.

THE GUIDE TO SOUTH AND EAST AFRICA. Edited by A. Samler Brown and G. Gordon Brown. *1914 Edition.* Pp. liv+695. (London: Sampson Low, Marston & Co.) 1*s.*

THE SETTLER AND SOUTH AFRICA. By W. Macdonald, D.Sc. Pp. 159. (London: Union-Castle Mail Steamship Company.) *6d.*

BEYOND THE PIR PANJAL. By E. F. Neve, M.D. Pp. viii + 178. (London: Church Missionary Society.) *2s. 6d.*

ALL ABOUT COCONUTS. By R. Belfort and A. J. Hoyer. Pp. xii + 201. (London: St. Catherine Press.) *6s.* net.

COCONUT CULTIVATION AND PLANTATION MACHINERY. By H. L. Coghlan and J. W. Hinchley. Pp. x+128. (London: Crosby Lockwood & Co.) *3s. 6d.*

THE CULTIVATION OF THE OIL PALM. By F. M. Milligan. Pp. xii + 100. (London: Crosby Lockwood & Co.) *2s. 6d.* net.

MAIZE: ITS HISTORY, CULTIVATION, HANDLING, AND USES. By J. Burtt-Davy, F.L.S. Pp. xl + 831. (London: Longmans, Green & Co.) 25*s.* net.

BROOMHALL'S CORN TRADE YEAR BOOK. Pp. 96. (Liverpool: The Northern Publishing Company; London: "The Corn Trade News.") 6*s.* net.

HANDBOEK VOOR CULTUUR- EN HANDELSONDERNEMINGEN IN NEDERLANDSCH-INDIË, 1914. Pp. x + 1655. (Amsterdam: J. H. de Bussy.) 10 florins.

A TEXTBOOK OF MEDICAL ENTOMOLOGY. By W. S. Patton, M.B., I.M.S., and F. W. Cragg, M.D., I.M.S., F.E.S. Pp. xxiii + 764. (London, Madras, and Calcutta: Christian Literature Society of India.) 21*s.*

THE "TIMES" AMERICAN RAILWAY NUMBER (English and French Editions), SHIPPING NUMBER, and TEXTILE NUMBERS. (London: "The Times.") 6*s.* net each.

THE WAY OF UNITY AND PEACE. Pp. 16. (London: Smith, Elder & Co.) 1*d.*